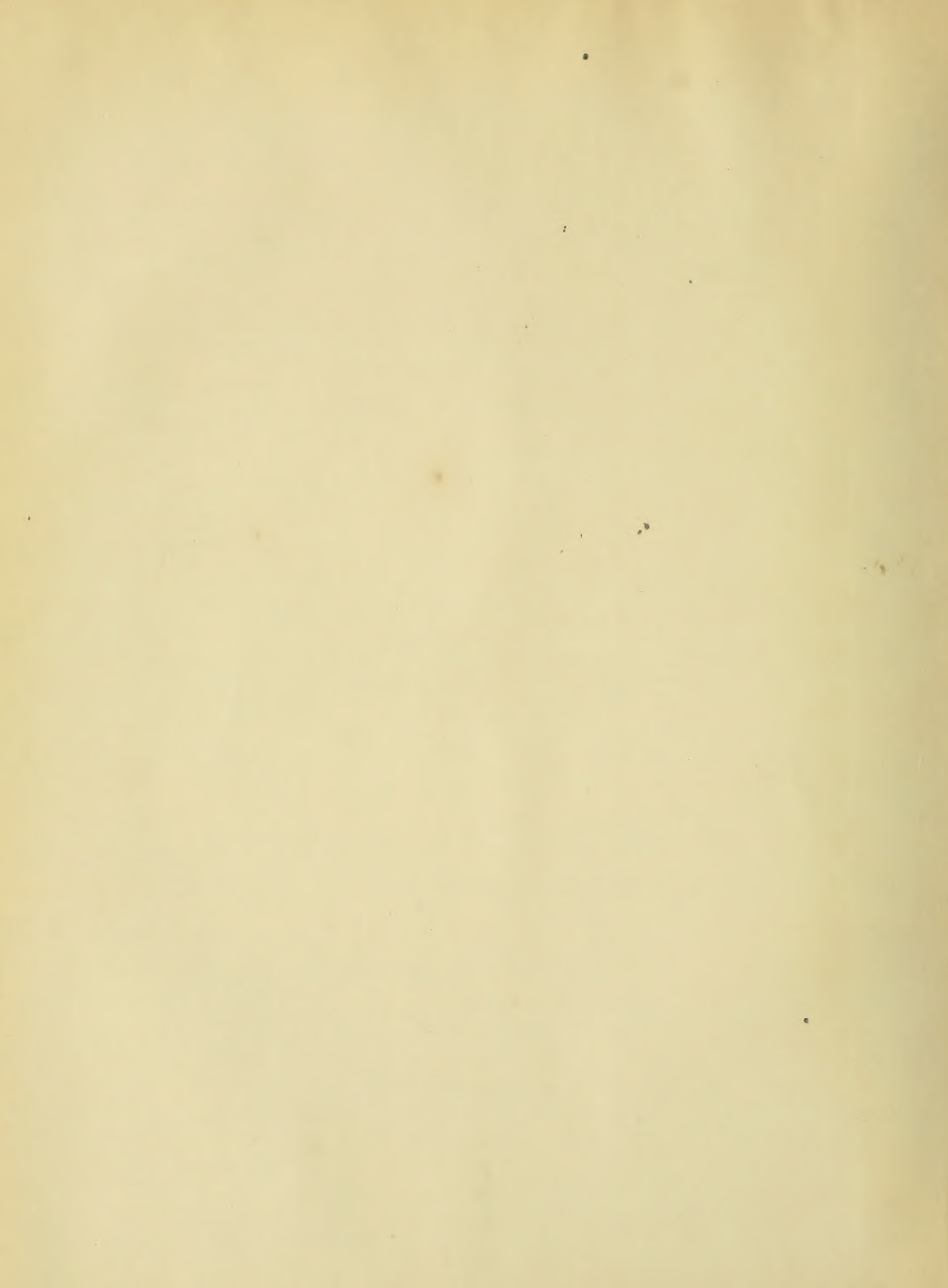








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THE AUSTRALIAN ZOOLOGIST

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Vol. 7.—1931-3

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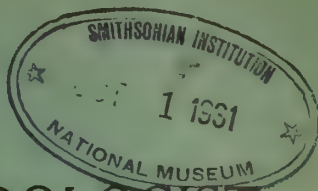
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THE AUSTRALIAN ZOOLOGIST



Issued by the
Royal Zoological Society of New South Wales

Edited by
A. F. BASSET HULL, C.F.A.O.U., F.R.E.S.

Vol. 7—Part 1

Sydney, August 24, 1931.

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Royal Zoological Society of New South Wales.

Established 1879.

REGISTERED UNDER THE COMPANIES ACT, 1899 (1917).

Patron:

His Excellency Sir Philip Woolcott Game, G.B.E., K.C.B., D.S.O.

COUNCIL, 1931-1932.

President:

Ellis Le Geyt Troughton.

Vice-Presidents:

Neville W. Cayley, Professor W. J. Dakin, D.Sc., J. R. Kinghorn, C.M.Z.S.,
and Anthony Musgrave, F.E.S.

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A. H. Chisholm, C.F.A.O.U.
W. W. Froggatt, F.R.Z.S.
Aubrey Halloran, B.A., LL.B.
K. A. Hindwood.

Tom Iredale, F.R.Z.S.
E. F. Pollock, J.P., F.R.G.S.
T. C. Roughley, F.R.Z.S.
G. A. Waterhouse, D.Sc., B.E., F.E.S.

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Hon. Treasurer: Phillip Shipway.

Hon. Librarian: A. S. Le Souef, C.M.Z.S.

Hon. Auditor: R. J. Stiffe, A.C.A. (Aust.)

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Avicultural Section.

Chairman: Frank Buckle.

Hon. Secretary: E. W. Jones.

Committee: Clifford Coles, C.M.Z.S., H.
E. Peir and W. Turner.

Marine Zoological Section.

Chairman: Tom Iredale, F.R.Z.S.

Vice-Chairman: G. P. Whitley.

Hon. Secretary: W. Boardman.

Ornithological Section.

Chairman: Tom Iredale, F.R.Z.S.

Vice-Chairman: K. A. Hindwood.

Hon. Secretary: Neville W. Cayley.

Assistant Hon. Secretary: Clifford Coles,
C.M.Z.S.

Committee: A. H. Chisholm, P. A.
Gilbert, J. R. Kinghorn, C.M.Z.S.,
Norman Chaffer, and A. F. Basset
Hull.

Hon. Secretary Field Club: K. A. Hind-
wood.

Royal Zoological Society of New South Wales

THE ANNUAL MEETING, 1930-31.

The fifty-second annual meeting of the Royal Zoological Society of New South Wales was held at Science House, Sydney, on Thursday, 30th July, 1931, at 8 p.m. His Excellency the Governor (Sir Philip Game) Patron of the Society, and 95 members and visitors were present. The honorary secretary (Mr. Basset Hull) read the

FIFTY-SECOND ANNUAL REPORT.

Members.

On 30th June, 1931, there were 507 members on the register, divided into the various categories, as follows:—Associate benefactors, 4; life members, 26; ordinary members, 286; honorary members, 6; honorary associate members, 5; life associate members, 20; associate members, 160. Four members died during the year, twenty-three resigned, and the names of 28 were removed from the register under Article 9. Forty new members were elected, leaving a net reduction of fifteen, as compared with 1929-30. This result is only what might have been anticipated as a consequence of the general depression. Notwithstanding the practically nominal amount of the subscription (as compared with the benefits conferred on members) this class of expense is generally the first to fall under the guillotine of reduction. A further cause of the reduction in the number of members on the register has been the removal of many who have failed (in some cases for two years) to pay their subscriptions, or to take the trouble to send in their resignations.

The Council.

Dr. E. A. D'Ombraïn resigned during the year, and Mr. Keith A. Hindwood was elected to fill the vacancy.

Twelve meetings of the Council were held during the year, at which the attendances were very satisfactory. Mr. Bryce was absent, travelling in Central and South America.

Sections.

Owing to the departure from Sydney of some of our most prominent entomologists, and the resulting small attendances at meetings, the Entomological Section has temporarily discontinued to function. The other three Sections—Avicultural, Marine Zoological, and Ornithological—have maintained a consistently high standard in attendance of members, and interest in the discussions and lecturettes which have been provided by the executive officers. A general meeting, open to all members and their friends was held at the Australian Museum, as an experiment, representations having been made that such a meeting would be appreciated. The result, however, was not encouraging, few beyond the usual sectional enthusiasts attending. Professor Dakin delivered an illustrated lecturette on "Plankton," and exhibits were shown and described by Messrs. Roughley (Oysters), Musgrave (Trapdoor Spiders), and Boardman (Gordian Worms).

SEP 30 1931

"The Australian Zoologist."

Parts 3 and 4, completing Volume 6, were issued during the year, the number of pages and plates constituting a record for any one year since the Society commenced publishing a journal, a period of seventeen years.

Exchanges.

The list of Societies and Institutions with which we exchange publications is steadily increasing, the latest countries to be added being China, Czecho-Slovakia, Germany, Latvia, and Russia. Cordial appreciation of our journal is expressed by our new exchange correspondents.

Finances.

Despite the financial depression, the year's operations have been most encouraging. For the first time our balance sheet includes the library and other assets, at a conservative valuation. The closing of the Government Savings Bank, and the consequent tying up of our current account compelled us to make arrangements with the Commonwealth Bank for temporary accommodation to meet current expenses.

Hand Book Publication Fund.

While this Fund is gradually increasing, it is still far from the required amount of capital to ensure sufficient income to defray the cost of a handbook. A work on the marine zoology of Port Jackson and the neighbouring coast is in preparation for publication when funds admit.

Fauna Protection.

The recent removal of the protection from the Opossum was opposed by your Council, and it is sincerely to be regretted that the representations of this and other Societies and individuals were unsuccessful. While it was claimed that extreme care would be exercised in the issue of permits to kill Opossums, and strict rules as to the methods to be employed were promulgated, the resulting slaughter was carried out in the usual un-economic manner. Probably 50 per cent. of the skins taken represented females carrying young, which were uselessly destroyed. So long as our so-called protection laws are subject to suspension at a few days' notice by a Minister acting under political pressure, so long will the continued existence of our native fauna be threatened. Apart from the humanitarian aspect of the question, the succession of open and close seasons, and the absolutely unregulated killing of females, can only result in destroying a market for furs, which requires continuous supply and high average quality. To shut down the industry for several years, and then rush on to the market a quantity of hastily prepared skins for a few weeks or months is calculated to seriously affect the demand, and consequently the price of skins.

Other Activities.

At the request of the Department of Agriculture and Forestry, Hawaii, the Society arranged for a series of shipments of oyster spat for experiments in cultivation. By latest advices these shipments were most successful, very few of the young oysters dying on the voyage. After nearly two years of growth in prepared beds, young oysters, identified as the spat of our exported species, were found in encouraging quantities. As there are no indigenous oysters in the Hawaiian Islands, and experimental cultivation of Virginian oysters had proved a failure, the success resulting from the Sydney shipments is very gratifying.

Numerous communications are received from persons keeping animals or birds in captivity, seeking information on various points, most of which has been available on reference to one or other of our specialists.

The keeping of fish alive for marketing has also been the subject of inquiry, and dealt with by members of the Aquarium Society, which meets in our rooms.

The honorary treasurer (Mr. Phillip Shipway) then presented the balance sheet for the year ended 30th June, 1931.

Governor Moves Adoption of Report.

His Excellency the Governor moved the adoption of the annual report and balance sheet. After congratulating the Society upon making its expenditure keep within its income, he proceeded: "It is not alone in this respect, but it is certainly in the minority! The enormous depredations on the fauna and flora of Australia are to be deeply regretted. This appears to be largely owing to the lack of interest on the part of the general public, a remarkable and disappointing feature, considering that the fauna is perhaps the most interesting in the world. Anyone who has discovered, as I have, the immense trouble that the Lyre Bird takes to build its nest, and knows that it can have only one chance of hatching its egg in a season, will be very chary of interfering with its nest. I am not seriously finding fault with the public whose lack of interest appears largely due to ignorance. The interest can be aroused, for example, the number of people who go to see the Native Bears at Koala Park may be cited. Every natural child is fond of animals and wants to know all about them. I have three of my own, and know of their love for Kipling's 'Jungle Book' and other nature stories. It seems to me that the lack of interest is among the 'grown-ups.' The Boy Scouts and Girl Guides offer a big field for cultivating interest in our native fauna. A few weeks ago I was camping in National Park with some Commissioners and Scout masters. On our rambles we were accompanied by an anthropologist, a botanist, and a geologist, but we missed big opportunities by not having a zoologist. So far as I can see modern science is going to result in shorter hours of work all round. A big problem will be what we are going to do with our leisure. Surely the study of the fauna and flora of one's native land is one of the best ways of employing such leisure. Let us therefore begin with the children, before they get too old."

Colonel Alfred Spain, chairman of Taronga Park Trust, seconded the motion, and referred to his long association with the Society, as a life member and past president. The report and balance sheet were adopted.

Election of Council.

The six members of Council who retired under Article 23, viz.: Messrs. Clifford Coles, K. A. Hindwood, J. R. Kinghorn, T. C. Roughley, Phillip Shipway, and Dr. G. A. Waterhouse were re-elected.

The president (Professor W. J. Dakin) then delivered his presidential address (vide p. 15).

Sir Edgeworth David, K.B.E., in moving a vote of thanks to the president for his address, referred to the valuable research work in marine biology now being carried on by Professor Dakin and his colleagues.

ROYAL ZOOLOGICAL SOCIETY OF NEW SOUTH WALES.

BALANCE SHEET AS AT 30th JUNE, 1931.

[illegible]

HAND BOOK FUND INCOME ACCOUNT.

Twelve Months ended 30th June, 1931.

RECEIPTS.			DISBURSEMENTS.		
	£	s. d.		£	s. d.
To Balance at 30th June, 1930.—			By Investment—		
„ Govt. Savings Bank			„ Commonwealth		
of N.S.W.	70	4 2	Treasury Bond .		96 5 0
„ Cash on Hand ..	9	3 11	„ Balance at 30th June, 1931.—		
			„ Government Sav-		
„ Hand Book Sales—			ings Bank of		
“Loricates”	1	6 8	N.S.W.	47	9 5
“Fishes of N.S.W.”	7	12 6	„ Cash on Hand ..	13	19 4
		8 19 2			61 8 9
„ Proceeds Annual					
Ball		27 8 6			
„ Interest on In-					
vestments		41 18 0			
	£157	13 9		£157	13 9

Twelve Months ended 30th June, 1931.

[illegible]

I have examined the books and vouchers of the Royal Zoological Society of New South Wales for the twelve months ended 30th June, 1931, and certify that the above Balance Sheet and accompanying Statements are properly drawn up so as to exhibit a true and correct view of the state of the Society's affairs as at 30th June, 1931, and the transactions for the year ended that date respectively, as disclosed by the books of the Society and information supplied.

ROBT. J. STIFFE, A.C.A. (Aust.).

Hon. Auditor,

Sydney, 20th July, 1931.

PHILLIP SHIPWAY

Hon. Treasurer.

ROYAL ZOOLOGICAL SOCIETY OF N.S.W.

Election of Officers for 1931-32.

The following officers were elected:—

President.—E. L. Troughton.

Vice-Presidents.—Neville W. Cayley, Professor W. J. Dakin, J. R. Kinghorn, C.M.Z.S., and Anthony Musgrave, F.E.S.

Honorary Secretary and Editor.—A. F. Basset Hull, F.R.Z.S.

Assistant Honorary Secretary.—Clifford Coles, C.M.Z.S.

Honorary Treasurer.—Phillip Shipway.

Honorary Librarian.—A. S. Le Souef, C.M.Z.S.

New Member of Council.

Mr. D. G. Stead has resigned his membership of the Society, and Mr. Tom Iredale, F.R.Z.S., has been elected to fill the vacancy in the Council thus created. Mr. Iredale is Conchologist at the Australian Museum, Sydney, and has contributed many papers to *The Australian Zoologist*.

New Members.

The following new members have been elected since the publication of the last list (February 13, 1931):—

Ordinary Members.—A. P. Cox, W. H. Curran, G. M. Cobham, C. Gietz, Dr. H. V. Horder, C. F. Hill, A. E. Irons, L. G. Isaac, R. O. Jarvis, Cyril D. Johnston, Claude Johnston, Miss V. Jones, H. J. Muston, F. C. Mackillop, B. H. McLachlan, A. H. Neale, M. J. Playoust, Mrs. B. S. Rhodes, Miss G. M. Rowling, F. S. Smith, H. Storey, R. H. Spring, G. St. Heaps, J. St. Heaps, A. L. Turner, and J. M. Williams.

Associate Members.—C. W. Brazenor, D. H. Graham, M. Paine, S. E. Sandoz, and T. H. Wooster.

SYLLABUS OF SECTIONAL MEETINGS, 1931-32.

Avicultural Section.

(Second Monday in the month.)

14 September 1931	11 January 1932
12 October "	8 February "
9 November "	14 March "
14 December "	11 April "
	9 May "
	13 June "

Marine Zoological Section.

(First Monday in the month, except when a Public Holiday, then on the following Tuesday.)

7 September 1931	4 January 1932
6 Oct. (Tues.) "	1 February "
2 November "	7 March "
7 December "	4 Ap. (Tues.) "
	2 May "
	7 June (Tues.) "

Ornithological Section.

(Third Friday in the month.)

21 August 1931	15 January 1932	Meetings of the Sections are held at
18 September "	19 February "	the Society's office, Bull's Chambers,
16 October "	18 March "	28 Martin Place, Sydney, at 7.30 p.m.,
20 November "	15 April "	and are open to all members, associates,
18 December "	20 May "	and their friends.
	17 June "	

Notices will be sent to members when a change is made in the date of a meeting.

REPORTS OF SECTIONS.

ORNITHOLOGICAL SECTION.

The activities of the Section during the past year (July, 1930—June, 1931), have been both interesting and instructive to members. Meetings were well attended, and the lecturettes and subjects discussed were much appreciated. Accurate field work, especially by many of the younger workers, was a feature of the year. The privilege of using the cottage at Gundamaian was not availed of to the fullest extent; but the bird cabin at Waterfall has been in constant use, and the observations from this station have amply justified its existence. To Mr. R. Gannon congratulations are offered for his notes on the Satin Bower-bird and its method of painting the bower. Other members also obtained records of interest concerning this remarkable species.

His Excellency the Governor, Sir Philip Game, and a party of Scoutmasters spent an enjoyable week in the park, under the guidance of Messrs. Cheel, Hodge-Smith, Thorpe, and Chisholm.

The death of one of Australia's ornithologists, Mr. Harry Wolstenholme, was a severe loss to the Section. Mr. Wolstenholme's wonderful gift of taming wild birds was well-known to those members who visited his home at Wahroonga. His work in connection with the R.A.O.U. check-list and his scholarly treatise on the scientific names of Australian birds, which is given as an appendix to the check-list, remains as a fitting memorial to a gentleman who really loved the birds he wrote about.

Congratulations are offered to two members of the Section, Mr. A. F. Basset Hull and Mr. Tom Iredale, on their election as Fellows of the Royal Zoological Society of New South Wales.

Many fine photographs of birds and bush scenes were secured, several new species, photographically, being added. The work in this field is equal to the results of previous years. Special mention may be made of the filming of several species by Mr. Norman Chaffer.

The greatest number present at any one meeting was 41 (July 20th, 1930), the least 19 (January 16th), with an average attendance of 23. At the July, 1930, meeting it was agreed that notice cards would not be mailed to members in future; apparently this caused a drop in the attendance, so that the practice was resumed again, or partly so, in April of this year. Notices of meetings are now sent to those members desiring such notification.

A summary of the lectures delivered at the twelve Friday meetings held during the year is given hereunder.

1930—

July 20th.—Mr. Harold Fletcher. "Antarctic Birds," illustrated with beautiful lantern slides.

August 15th.—Mr. E. F. Pollock. "Animal Photographs."

October 17th.—Mr. J. R. Kinghorn. "Economic Ornithology."

December 19th.—Mr. N. W. Cayley. Drawings of Hybrid Finches. Mr. K. A. Hindwood. Bird Photographs.

1931—

January 16th.—Mr. Norman Chaffer. Bird Photographs.

February 20th.—Mr. Tom Iredale. Talk on Dotterels.

March 20th.—Lantern slides, by Mr. J. Ramsay. Discussion on Cuckoos.

April 17th.—General discussion. Notes on the Banded Stilt.

May 15th.—Discussion. "What is a Species?" Mr. Anthony Musgrave. "Early Australian Insect Collectors," illustrated with lantern slides, many of them wonderfully coloured by the hand of the lecturer.

June 19th.—Annual meeting. Election of office-bearers. Chairman's address.

N. W. CAYLEY, Hon. Secretary.

NATIONAL PARK RESEARCH COMMITTEE.

Only one meeting was held during the year, on December 12, 1930. The material for the Biological Section of the proposed handbook to National Park is well in hand, but owing to the prevalent financial depression its publication has been indefinitely deferred.

Members of the Society continue to visit the cottage and cabin to study the fauna of the Park.

GILBERT P. WHITLEY, Hon. Secretary.

MARINE ZOOLOGICAL SECTION.

The Marine Section held its fourth annual meeting on Wednesday, 10th June. The year has been an energetic and a fruitful one, energetic insofar as nearly every member of the Section has been actively engaged on the writing of the proposed handbook of the local marine fauna and flora, fruitful in that the work now completed has been submitted to the Council. The appearance of the handbook will be a real landmark in the progress of marine zoology in New South Wales, and will fill a long-felt want with both lay and professional readers. It seems a remarkable fact that in a city of the size of Sydney, built on the shores of one of the world's greatest harbours, and adjacent to miles of virgin coast line, it is not possible to purchase a work dealing in a popular manner with the denizens of the local coast.

During the year the practice has been adopted of holding occasionally an open night to encourage members to bring and describe exhibits and start discussions. It seems that a night of this type can be made quite as interesting and enjoyable as those devoted to a good lecture.

Mr. G. P. Whitley was unanimously elected to the chair, and Mr. McNeill to the position of vice-chairman for the ensuing year; Mr. Boardman will continue to act as secretary.

The lectures delivered to the members have been of consistently high quality, and a list follows:—

1930—

September 1st.—"Queer Fish." By Mr. G. P. Whitley.

October 7th.—"Nudibranch Molluscs." By Miss Joyce K. Allan.

December 16th.—"The Continental Shelf." A series of lantern lectures by various members.

1931—

February 2nd.—"A Year on the Great Barrier Reef." A lantern review by Mr. T. C. Roughley, of Dr. C. M. Yonge's book of that name.

April 7th.—"Fish Meals—A Useful Food Product." By Mr. T. C. Roughley.

TOM IREDALE, Chairman.
W. BOARDMAN, Hon. Secretary.

AVICULTURAL SECTION.

I have to report that the popularity of the Avicultural Section has been amply evidenced by the interest taken by members in its monthly meetings, the average attendance being 22 during the past year.

A series of very interesting lecturettes and discussions on topical subjects pertaining to successful management of aviaries and their inmates, together with several illustrated talks on Australia's wonderful collection of Parrots and Finches, by Mr. Neville Cayley, has at all times proved interesting, educational and beneficial to members.

It is the intention of the executive to mould this Section into a mutual aid Society, and in order to do so it appeals to those of its members who have experienced marked success from time to time, to bring their joys to the meetings and make them known and to enlighten others by describing how their success was accomplished. On the other hand, it invites those who have been less fortunate in having suffered reverses to ventilate their troubles, so that they may be discussed with a view to preventing a recurrence of their setbacks, remembering that it is from one another that we hope to learn how to become expert in the art of keeping our feathered pets in comfort and with a maximum of success. If the executive achieves its object, which I feel sure it must, with the loyal support of its members, the Avicultural Section will long continue to be very popular.

ERNEST W. JONES, Hon. Secretary.

BIRD NOTES.

Broadcasting the Lyre Bird Song.

An interesting development in ornithology of late has been the broadcasting of the fantasia of the Lyre-bird (*Menura novae-hollandiae*). Mr. R. T. Littlejohns, Melbourne naturalist, co-operated with Australian Sound Films during June, 1931, in the securing of a sound-film, this being obtained through placing a microphone near a display-mound and having about 500 yards of wire connecting with the recording apparatus. Mr. A. W. Wynne, a director of A.S.F., brought the film to Sydney shortly afterwards, and on July 2 this was put "over the air" by Station 2 U.W., together with introductory remarks by Mr. A. H. Chisholm, C.F.A.O.U. The film was described by Mr. Chisholm as an excellent one, embracing the songs of seven or eight different species of birds, and including a remarkable etherealized version of the "laughter" of the Kookaburra. A few days later the sound-film of the Lyre-bird's medley of mockery was broadcast to America, again with an introduction by Mr. Chisholm, who had previously arranged for several American scientists to "listen-in." Incidentally, the Governor (Sir Philip Game) patron of this Society, and Lady Game were given a private audition of the sound-film, and, subsequently, Lady Murray, of Papua, and Colonel Gannon, of India, attended at the Amalgamated Wireless studio for the American broadcast. Meanwhile, direct transmission of a Lyre-bird's chorus was carried out by 3 L.O. (Melbourne), with the aid of Mr. T. H. Tregallas, and a very fair measure of success was achieved, the bird being persuaded to sing before a mirror. Between the broadcasting of the sound-film and the transmission of the song from the bird itself, a large measure of popular interest has been aroused in the melody of this, one of the world's most remarkable bird-vocalists.

Tom and His Bird Pals.

(Plate i.)

Recently a friend of mine told me that there was an old age pensioner living at Kuringai, who could whistle to the wild birds and they would come down from the trees and feed out of his hand. At the first opportunity I packed up my camera, made my way thence, and found that there was little exaggeration in my friend's statement.

Tom Wren is the man's name (possibly it accounts for his "mateship with birds"), but he is generally known as just plain Tom.

He lives in a tent and has a small patch of ground, which he cultivates.

I had not been long introduced before a Grey Thrush (*Colluricincla harmonica*) perched on the gate.

"Ah," said Tom, "here is one of my pals." The Thrush immediately flew down on to Tom's outstretched hand and picked up a piece of cheese.

I noticed a Willie Wagtail (*Rhipidura leucophrys*) sitting on a perch nearby. "Watch him," said Tom, "when I throw a piece of cheese up. He never misses." Up went the cheese and Willie Wagtail made a neat catch. I tried my hand at the game and found that he did miss sometimes, though rarely. Another Thrush appeared on the scene.

"The young one," Tom explained, as the Thrush flew down on to his outstretched hand. I thought it was about time to get the camera busy, so I got Tom out into the sunlight, and with the black cloth over my head began to focus up. I had hardly begun when a Thrush alighted on my head and remained there until I had finished. Tom then induced the bird to stand on his head (Tom's head, I mean), and I took a photograph with it in that and also in several other positions. The birds are quite fearless, and one is astounded at the familiar manner in which they act. Tom says if he is not up early enough in the morning a Thrush comes into the tent, hops all over him, and even pulls his hair.

He says that a Peewee (*Grallina cyanoleuca*) which visits him is almost a nuisance, because of the way it has of alighting on his head at unexpected moments.

Plates were rapidly exposed until there was none left, and I did not get a satisfactory picture of the Peewee.

However, on another occasion, in company with Mr. K. A. Hindwood and a friend of his, we got Tom with the Peewee perched on his hand.

It was somewhat amusing to hear Mr. Hindwood request Tom to hold the bird a little higher, and then ask him to turn the bird's head round more to the light.

The Peewee took the procedure quite calmly and allowed several plates to be exposed. Much more could be written of the association which exists between Tom and the birds, but I will conclude with a few remarks about Tom himself.

He is an old miner, a nonpretentious, fearless, honest old chap, and lives by himself. He has looked upon the birds as pals, and for several years has been gaining their confidence by leaving scraps for them, until they are now absolutely fearless.

Irresponsible youths at times use pea rifles in the vicinity, and Tom is always anxious about his pals whenever he hears the crack of a rifle. Near Tom's place is a cemetery which contains thirty cats. One wonders where they all come from!

G. R. GANNON.

"MIRRAM"—"LITTLE HAPPY ONE."

By FLORENCE M. IRBY.

(Communicated by A. H. Chisholm.)

Sugar Squirrels (*Petaurus breviceps*) must be numerous in open forest country in many parts of Australia, but owing to their nocturnal habits they are not frequently seen.

When the gum-trees are flowering, one can hear them at night quarrelling as they romp and revel among the honey-sweet blossoms; for the Sugar Squirrel is, above all else, a lover of flowers, taking at night the place occupied by the honey-eating birds during the day. Every now and again one picks up a thick fluffy tail—soft and light as thistledown—telling of some dark tragedy enacted, when fox or cat has sprung upon the unsuspecting mite, as, having floated with outspread "wings" to earth, it turns to scamper up the tree again. Falling trees, too, take severe toll of these soft and seemingly boneless creatures, for the shock almost invariably kills them. An opossum will spring as the tree falls and scamper uninjured up the nearest trunk; but not so the frail bit of fluff that constitutes a Sugar Squirrel. With a drop of blood oozing from between clenched teeth, it will quiver once or twice, then lie still.

Usually only one little one is born, but occasionally a mother Squirrel has twins. A family of such was killed when a tree fell near our house, during a gale, killing instantly the mother and both well-furred babes—soft, almost formless bits of fur, scarcely more noticeable to hold than if a couple of feathers were in one's palm. Domestic cats also take great toll of Sugar Squirrels; probably their curiosity is their undoing, for an intense inquisitiveness appears to be one of the Sugar Squirrel's ruling passions.

I had always desired to study one of these small animals at close quarters, and recently had an exceptional opportunity to do so. During the first week of November, 1930, on a raw, foggy morning, beneath a tangle of ferns and orchids in the garden lay the stiff, almost frozen body of a beautiful little Sugar Squirrel. The cats had killed her. The lovely fur was damp and soiled, and the long, bushy tail, once her pride, had been dragged through the wet grass until it resembled a piece of wet rag. She must have been dead nearly all night. We lifted her up, pityingly, wondering why so much life and beauty should have been so wantonly wasted. Startled, we saw one tiny portion of the body breathing. It looked as though the tiny heart throbbed on, though the rest of the body had been dead for hours. Then our wonder turned to rejoicing, for the opening to a small pouch was seen, and in its safeness something almost incredibly tiny moved and breathed.

I had seen marsupials of many kinds in earliest embryo stage, but had never attempted to rear one unless fully formed, having been assured by trappers and others of the impossibility of doing so. They are held on by suction, and just as you will sometimes find that a jar of jam or bottled fruit with a rubber ring under the glass lid will be almost impossible to open, so are these tiny creatures held by a ring, which eventually develops into a mouth. As for the drop of blood which many tell you forms if you take one of these immature creatures from the mother's nipple, why, they are so delicately formed that any rough pull would probably sever the tongue, and the marsupial would naturally bleed to death, for in its initial stage the tongue is probably the only portion of the tiny body in which blood enough to form a drop is contained. Bearing this in mind, I

loosened it with my finger-tips with the greatest care. With no little difficulty it was detached from the mother, for it was fastened so firmly to her nipple by suction that eventually it was only removed by force.

Judging by the little creature's size and unformed condition, we imagined it had only been born about two days previously, perhaps even that night. It was repulsive in its ugliness—just over an inch in length, tail nearly two inches, a red, naked body with a darkish pencilled line along the back culminating in a diamond-shaped patch on the face. It was mostly head, had no eyes, and the mouth seemed to consist of a thick circular lip like the mouth of a bottle. The tongue was a scarlet thread. For the rest, it seemed little more than a piece of inflated skin, with a backbone and limbs attached. *It was so small that when curled tightly up it fitted comfortably on a shilling.*

All the while the little creature lay in the palm of my hand the poor, shapeless head moved restlessly, searching for the dead mother's nipple. Although absolutely sightless, if laid down at some distance from the hand, it would wriggle its formless body along until it found it, even if the hand was held over a foot away. I experimented with this many times, as I had frequently heard it said that the embryo marsupials were so utterly helpless that they would be unable, unassisted, to find their way into the mother's pouch, and each time some sense or instinct led the small, blind thing direct to the warmth of the outstretched hand.

It seemed hopeless to try and save a creature so small, young and unformed—one could only press its mouth into a teaspoonful of warm milk and water every hour or so. Without seeming to drink it must have absorbed a little of the beverage, for next day, to our surprise, it was still alive. At the end of two days of spoon-feeding the shape of the mouth completely changed, forming two normal lips. When cold or hungry it cried, uttering a sound not unlike the faint echo of the buzz of a Cockchafer Beetle. At the age of four days it lapped milk and water from the spoon like a kitten. At the same "advanced" age it would sometimes squeak, just about as loudly as a baby mouse. At five days it began to darken all over. At six days its skin-covered eyes were bulging from its head like boiled currants, and it would squirm all over one's hand in a search for food, and curl up contentedly directly it was fed.

At ten days the upper part of the body was covered with a dark microscopic down, the head and underparts being still uncovered. At twelve days the baby showed a violent shrinking from light, hiding its face if taken into the sun or near a lamp or candle. At the same date the nails hardened on the end of its tiny claws. The heart could always be heard beating like the ticking of a watch through the thin skin tightly drawn over the tiny frame. It was so transparent that it resembled the skin of a child's toy balloon. Tiny ribs began to show beneath it, and the drop of milk swallowed showed plainly through.

At thirteen days there was a seam across the centre of each embryo eye, showing distinctly the forming of lids. At fourteen days the lids were fully formed. From this date the tiny creature became quite painfully sensitive to light. In the dark it would now crawl about one's hand and arm quite briskly, holding on so firmly that it was difficult to dislodge. By this time it had begun to look quite plump and shapely, and had more than doubled in size. It could drink almost a quarter of a teaspoonful of milk and water at a sitting. Its limbs were almost rounded, and after each meal its sides bulged like the sides of a celluloid kewpie doll.

At three weeks the skin grew very loose and wrinkled, the hair on its back and the diamond-shaped patch on the face darkening and growing thicker. At three weeks, also, it began to wash its hands and face feebly, often tumbling over in its efforts. At four weeks its features were fully developed—it now looked like a real animal—and on the 5th of December, exactly four weeks from the day we found it, the eyes were partly open for the first time. At this time, also, it began to play, weakly, as a small kitten will, lying on its back and clutching at anything within its reach with tiny paws.

By this time it was the size of a very small mouse, and not unlike one in general appearance. The "flying" membranes, legs, and underparts of its body were still bare and unpleasantly transparent—it looked as if, should it by any mischance be pricked by a needle or pin, it would subside like a child's balloon. The back was still covered with dark mouse-coloured down. At six weeks the eyes were fully open and seemed to be out of all proportion to the small body; the ears were now long and dark, and small sharp teeth had appeared.

It now spent much time washing and scratching itself, and all the dark mousey hair came off in patches, giving the little creature a most curious piebald effect. During this week, also, red veins formed on the body and legs, and for the first time it seemed to have warmth in itself—hitherto it had felt like some dead thing unless kept wrapped in layers of flannel on a hot water bag. At this time also it first uttered the strange staccato note used if frightened or angry—the ordinary note of these Squirrels being a soft "cush, cushion," not unlike the call of an opossum. All its hair had now come off; even the dark line on the back and the diamond on the face had disappeared. In the seventh week the skin on the back grew bluish and roughened like goose-flesh; long sparse hairs began to grow on the back like the down that first forms on a fledgling bird; rings of short dark hair formed on the tail; the skin underneath and the legs and feet were still naked and pink.

At eight weeks it felt like a piece of velvet, the back being covered with very short bluish hair; the tail was now more fully furred, so that the rings of bare skin no longer showed so pronouncedly. The dark stripe along the back and the diamond-shaped mark on the forehead had appeared again, this time being much darker.

At the beginning of the ninth week short white down began to show on its legs. The little creature now looked something like a small rat. It grew venturesome, liking to creep out of its box and prowl about, and could clamber up on to a chair back and perform strange acrobatic feats. When given a tiny fragment of sugar, or half a raisin, it would sit up and eat most daintily; the food was usually held in the right foot, the fore-paws occasionally being used to help, but more often to hold on by. At the beginning of the ninth week, also, dark marks showed down the front of each fore-arm and were very black by the end of the week; the tail was also black, and like a very long rat's tail, though more furred.

At this time it became partly insectivorous; with astonishing agility it would clutch at and grasp any small moth or other insect flying by and eat it greedily; especially did it have a weakness for the larvae of hornets, climbing to and breaking open the mud nests in order to extract them.

The white fur underneath now thickened and dark fur covered the wings with an edging of purest white. It was now very strong, clinging so tightly to anything that it was almost impossible to shake it off. It

was as playful as a kitten. Although the fur was still short, it was now a beautiful little animal, complete in all markings and with a set of very sharp teeth and needle-like claws. Flanges had now lengthened right down the side of each fore-leg to the very tip of the little finger. It ate biscuits eagerly, and soon gave up using its foot to hold the food, using the fore-paws only.

The fur continued to grow thicker and softer, underneath buff, on top silver grey. With its markings of black and white it was a lovely thing, and by the time it was three months of age was a perfect ball of fur. The tail was beautifully wavy, and the Squirrel now spent much time working with teeth and claws combing every hair backwards. The first part of the tail was ringed—dark grey and light—and the other half was black. But this changed shortly, the ringed part becoming silver grey, and the other half remaining black.

At four months it was a perfect replica of the mother, although but half the size. A gentle, sleepy little creature by day, just waking up for a drink of milk or a piece of bread or biscuit, it would then curl its tail tightly across its face and around its ball of a body and sleep so for hours. But with dusk it became a fiery sprite. With eyes shining like bits of jet, and drawing its breath with a whistling sound, it would tear round the room like a whirlwind, dash up a window curtain, or spring on to anyone near. It would destroy a large vase of flowers in its eagerness to suck the drop of honey there might be in each, and woe-betide the luckless insect that drew near. The shrilling of a cricket sent it almost crazy, and it would chase one round a room as a cat chases a mouse, pouncing on it and tearing it limb from limb. It loved silver-fish, and, above all things, the great black and gold dragon flies that floated over the grass at night. Let one venture near and its day was done; only the gauzy wings remained to tell the tale. The Squirrel had wonderful sight. I have seen it prick up its ears suddenly and dash to the top of a high book-shelf to pounce upon a "daddy-long-legs" swinging comfortably there.

Deliriously happy little creature of the night, it is curled up now, beside me, a biscuit clutched in one small pink paw, too lazy even to eat, as it dreams of honey-scented flowers and the winged things it will catch to-night.

MIGRATIONS AND PRODUCTIVITY IN THE SEA.

A Study of the Factors Controlling Marine Organisms with some
Reference to New South Wales Fishing Problems.

PRESIDENTIAL ADDRESS.

By WILLIAM JOHN DAKIN, D.Sc., F.Z.S., F.L.S.,

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Biology in the University of Western Australia.

Plate ii.

No apology is necessary for choosing the field of marine biology for my presidential address. The sea means much to Sydney; the Southern Pacific Ocean is a region where oceanographic study is only just beginning. New South Wales is the only Australian State which has developed a trawling industry; and, although I intend to concentrate somewhat upon certain features in the living conditions of marine animals which have interested me for over 20 years, I hope you will find that the study is not without fascination, whether viewed from the aspect of pure knowledge or applied science.

It is surely most essential in these days of specialisation, when zoology has passed from the descriptive to the experimental, for the discoveries of the specialist in one sharply limited branch to be gathered in to the common store. As Singer puts it: "Science must perish from off the goodly land into which its specialist leaders have brought it from out the wilderness of mediaeval ratiocination, unless the division of knowledge which ultimately would make each investigator intelligible only to himself is adjusted by the incorporation of new knowledge into the general stock."

The subject I have chosen appears to me particularly suitable, for it not only embraces different branches of zoology, but it entails the work of the chemist, the physicist and the oceanographer, and may serve as a warning to those who expect that marine problems of economic importance should be solved in the "twinkling of an eye," or without any cost.

About the year 1886, Haeckel introduced the term Ecology for the study of the relations of organisms with their external world. This external world comprises (a) the physical environment; (b) the other living things in that environment. It is only to-day that zoologists are seriously attracted to the study, although specialists have for years been considering certain ecological problems.

The fishery experts of the North Sea endeavouring to determine the causes of the migrations and the abundance or scarcity of herring are considering an ecological problem. The marine zoologist concerned with the amount and character of that vast assemblage of organisms known as the plankton, investigates an ecological problem. The factors which direct, even if they do not determine, the migrations of birds, of fishes, whales, insects and other creatures are ecological factors. It is the ecological factors concerning the well-being, and therefore both the productivity and migrations of marine animals that I wish to bring to your notice in this address.

MIGRATION.

If changes take place in the physical or biological characters of some marine environment, they will be reflected in the metabolism of the animal

population, and, since the sea is a continuous medium, with few or graded barriers, there is every facility for migration to more favourable regions. In the case of creatures which are restricted to a locality, any unfavourable changes in the environment will be reflected by a change in productivity. The greatest possibility for migration* is offered by aerial life; the sea comes an excellent and close second, and presents examples which are no less striking than the puzzling migration of the birds. Let me enumerate a few interesting examples:—

(a) *Migration of the Salmon.*

The remarkable migration of the salmon from the sea into and up the rivers for the purpose of breeding has long been known. This fish performs the unusual feat of passing rather rapidly from a fluid of high salinity into fresh water which would be poisonous for most marine fish. It overcomes obstacles and the resistance of swiftly moving waters at the expense of stored products of its marine feeding period.

(b) *Migration of Eels.*

The migrations of the European river eel and American eel have also been mapped, and one problem of centuries been solved. This is not the place for details, but it is important to remember that the young eel after finding its way up some river, perhaps thousands of miles away from the Atlantic depths where it was produced, lives and wriggles in some muddy backwater for 7-10 years. Then something happens, without any environmental change. The first stirrings of that great stimulus, sex, awaken uneasiness and shall we say lack of harmony with the surroundings. The body changes in colour and form, the eyes enlarge, the fish ceases to feed, and, descending the river, it passes out to the deep sea. Eventually it reaches the breeding ground in the Western Atlantic, but how, remains unknown. It is no passive drift, for marked eels which have been recaptured show that at least 300 miles a month may be travelled. What factors determined this passage? What direction finder did the eel depend on? These are questions which face us time and again, even if not in so striking an example. The migrations mentioned illustrate admirably the movement of an aquatic creature from a feeding environment to a breeding environment.

(c) *Migration of Whales.*

The same thing is exhibited by the whales of the Australian coastal waters. These whales frequent Australian seas during the winter months. They come from the south, from the neighbourhood of the Antarctic ice, and their purpose is that of breeding. By the time of the Australian spring (September) these whales are all well on the way south, some with young, back to the colder regions, where surprisingly enough the small floating crustacea on which they feed are far more plentiful than elsewhere.

It is not my purpose here to discuss how these migratory movements of eel or whale, "cold blooded" fish and "warm blooded" mammal may have originated. We can easily imagine that the cold waters of the Antarctic are unfavourable for the breeding of a "warm blooded" animal, and we know that the food of the whalebone whales is most abundant in the colder seas.

* By migration is implied more or less regular and seasonal movements from one place to another, and not the passive drift of eggs in sea currents.

(d) *Migrations of Sharks and Rays.*

The sharks belong to a group of vertebrates, the Elasmobranchii, and are generally regarded with an unfriendly eye as fish with a cartilaginous skeleton and a potentiality for evil. Considered physiologically they are more different from the typical bony fishes than the latter are from man.

The Elasmobranchii are almost entirely marine creatures to-day, but a few wander into rivers and even reach fresh water. It is characteristic of several species that they move into brackish water of high dilution to lay their eggs or if viviparous to give birth to young. Whether the migration is a search for water of reduced salinity or the higher temperature of these shallow waters in summer (the time when migration takes place) remains to be discovered, but the peculiar saline conditions of the blood require to be taken into account.

(e) *Migration of the Eel Gudgeon of New South Wales.*

Another interesting example of a fish moving rapidly from water of ocean salinity to water of low salinity is apparently the case of the "Jolly Tail" of New South Wales streams. This fish is found in the rivers, but according to McCulloch it appears to migrate inwards from the sea in at least some cases. Young larvae only 38 mm. in length were found by McCulloch passing directly from the ocean into fresh water streams. In fact, that keen observer noted that the fish must be remarkably sensitive to the presence of fresh water—"the dilution in the ocean breakers would not be great—to discover the small stream they were ascending."

(f) *Migration of the Sea Mullet.*

The Sea Mullet of New South Wales migrates every winter out from brackish waters of the estuaries to ocean water of higher salinity to spawn.

(g) *The Migration of the "Lump Sucker" in the North Sea.*

I mention this example here because it has been the subject of certain of my experiments. The fish (*Cyclopterus lumpus*) lives in the deeper parts of the North Sea, but every springtime there is a remarkable migration of males and females into shallow water. The fish pair off and the eggs when laid are plastered on to rocks forming a thin layer. This may take place in such shallow water that the eggs are exposed at low tide, and the unfortunate male fish, who is left to guard the eggs until they hatch, is left "high and dry." Now if one of these fishes is kept in a sea-water aquarium during the breeding season, it appears to be quite healthy. But when the time comes for its "mates" in the sea to migrate to deeper waters again, the aquarium fish becomes pathological and succumbs. There is some very definite relation between certain conditions of the environment and the periodic physiological changes which take place within the body.

(h) *Migration of Marine Invertebrates.*

Migrations are not confined to the fishes. The invertebrates exhibit equally interesting examples, but comparatively inefficient organs of locomotion limit the ranges covered. Nudibranchs wander from sandy and muddy bottoms to rocky coasts. The edible crab (*Cancer pagurus*) of European waters leaves the tidal shores in autumn and moves out seawards into water of 20-30 fathoms depth, where it stops during winter. In Western Australia large numbers of the crab (*Portunus pelagicus*) are to be captured in the shallow water during summer, but the advent of the rains causes a complete migration to the sea or to the deeper holes, where

the water remains more saline. A more striking example still is supplied by several of the Penaeid prawns, which are so important commercially in Australian estuarine waters, and also in similar situations in India, Malaya and South Africa. The King Prawn and the School Prawn migrate far up the estuaries. The so-called lakes which open to the sea like Lake Illawarra, Tuggerah Lakes, and Lake Macquarie are at times crowded with them, and these regions are excellent feeding grounds. At certain times, however, the "call" comes, and an amazing movement to the sea takes place.

PLANKTON AND PRODUCTIVITY.

One cannot discuss the possible causes of migrations without considering the productivity of the sea, for if certain migrations are due to the onset of a breeding season, it is none the less evident that others are movements to richer food supplies. The nutrient value of the sea is, however, due to the presence of an amazing population of minute organisms which form an assemblage known as plankton. The investigation of the New South Wales plankton has been one line of our research at the University of Sydney for the past two years, but must be continued week by week for many more years to come.

Scattered through the water of the seas, lakes and rivers, from the surface to great depths, but most concentrated near the surface, is a vast world of living creatures, most of which are invisible to the naked eye. The water teems with minute animals and plants, the animals feeding upon each other and upon the plants, the latter ever building up living protoplasm from raw mineral substances. Actively swimming creatures like fish, whales, turtles, sea snakes, are excluded from the assemblage—not because they are large, but because it is convenient to group together all those organisms which have this one character in common—they drift passively in ocean currents, moved by tides or by the wind. Such is the plankton. It forms the closest link between the biological environment of the sea and the physico-chemical environment. For the plankton community the sea is a vast nutrient medium. If we regard it as such we shall realise the enormous productivity of the sea, and perhaps understand why man can remove half a million tons of herrings from the sea in a year and go on doing so. The land presents only surface area upon which to grow plants. The sea must be reckoned in cubic measure, and its surface far exceeds that of the land. There are, in fact, 324 millions of cubic miles of sea water.

The actual chemical composition of the plankton is not unlike that of rich pasture. The annual production of organic and inorganic matter in the plankton of the Baltic Sea is only 20 per cent. below that which could be produced on a similar area of land, even if it were all fertile.

It is essential to regard the plankton as consisting of producers and consumers. In the sea, as on land, the ultimate link in the chain between organic matter and what we style inorganic is the plant cell. The tiny animals of the plankton feed upon these plant cells and in their turn become food for larger animals. They are all consumers; the green plants which build up food from raw materials in solution are producers.

Two plankton problems are of particular interest from our present viewpoint: (1) The relative abundance of plankton in New South Wales waters as compared with other seas. This will be a measure of the productivity of our sea. (2) The seasonal changes in the quantity and quality of the plankton. It is for the purpose of answering these problems that I

have been making plankton catches at intervals of a fortnight for the last two years.

Up to date the size of our catches is very uniform, compared with the seasonal variations which are of such outstanding interest in the colder waters of the North Atlantic, where the plankton has so far been studied. But this does not mean that our plankton does not change in character. It varies, both in quality and quantity. Different organisms have different periods of greatest development, and it will be essential to find out what factors determine these maxima and their relations to young stages of fishes. But it may be a long time before this latter work is reached. A very striking result is that the biggest catches, with two marked exceptions, have been made in the summer months, and it is only then that the big Tunicates, Heteropods and colonial Radiolarians have been conspicuous. Possibly the explanation of this lies in the tropical southward flowing current which normally passes along our coast.

Although the plankton must be regarded as passively drifting southward in this current, it does not follow by any means that the constitution of the plankton will be the same at every point in its track. Differences in temperature in different latitudes will favour these or those species. The winter sea temperature off Sydney will not be so favourable for the tropical ocean plankton as the summer. Admixtures of river water and upwelling of sea water from the bottom along the coast will alter the composition of the water in both oxygen content, salinity and chemically in other ways.

Once each winter (1930 and 1931) we have witnessed the nearest thing to the great maxima of green plants (the diatoms) which is characteristic of cold northern hemisphere waters, but has never been noted for the south. The big catches of diatoms were only made, however, on one day each year (this means that they might have been present for a week and a half at the most). One naturally wonders where they appeared from. There are always some of the same diatom species to be found in small numbers.

Fortunately, this year, we have made temperature observations simultaneously with the plankton catches, and at all points between the surface and bottom. It is significant that the diatom plankton catch was accompanied by a temporary drop in the sea temperature. This can only mean an incursion of some colder sea current from the south or an upwelling of deeper ocean water along the coast. And either this current brought the diatoms or else the change in physico-chemical factors initiated a period of rapid reproduction on the part of those forms normally present.

All this may sound rather academic, but since the food of most of our fish in the tiny stage immediately after hatching consists of plankton organisms, a whole season's brood of fish may be stricken if unfavourable plankton fluctuations coincide with their appearance. Such a catastrophe might not be noticed for 3, 4, 5 or even more years, when there would be a curious falling off in the number of the adult fish. I shall refer to this again later.

It has been frequently said that the plankton of the warmer seas is less rich than that of colder waters. Many criticisms, however, have been brought against the statement. We have already obtained one interesting comparison, and probably it is one of the most reliable that has been made. For many years two nets were hauled twice a week in the Irish Sea. The average plankton catch was 14 c.c. Two similar nets hauled off Sydney

each fortnight for 2 years gives an average of only 4 c.c. Is this a measure of the relative productivity in fish food of the two regions?

And now with regard to the physico-chemical environment. The factors which determine the possibilities of life are set out in Figs. 1 and 2. There is no need to enumerate these factors, nor is there time to discuss them. I wish to stress one as an example, and I have chosen the problem of salinity, since the details are not generally appreciated by zoologists.

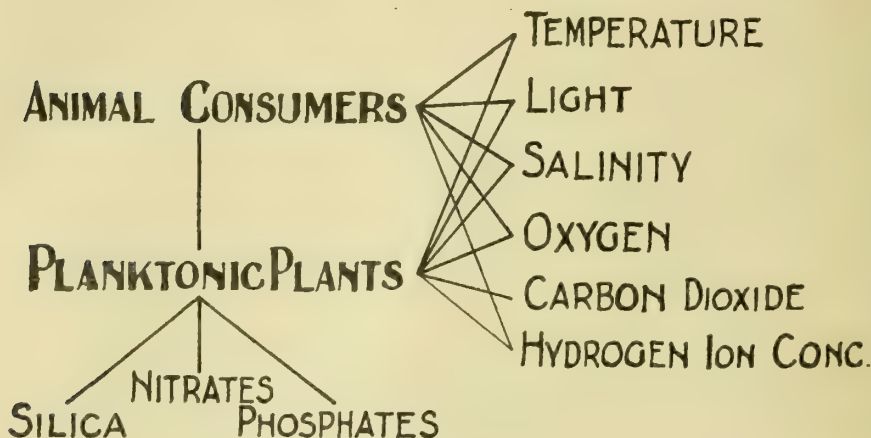


Fig. 1.

The composition of the water of the great oceans is extraordinarily constant in the relations of the various components. Even where the sea is diluted by fresh water as at river mouths, the relative proportions of the different salts remain the same. Unfortunately the "man in the street" (or should I say the fisher on the sea) regards the ocean as a solution of common salt—sodium chloride. It is true that sodium chloride is the most abundant salt, but a solution of sodium chloride of the same concentration as sea water would be more poisonous than distilled water to many if not most marine creatures. The principal substances present in sea water are per 1,000 parts of sea water:—

Sodium	10.722
Magnesium	1.316
Calcium	0.420
Potassium	0.382
Chlorine	19.324
SO ₄	2.696
CO ₃	0.074
Bromine	0.066
	35.000

Frequently these ions are represented in the form of salts, and the following mixture would, if made up artificially, approximate to sea water:—

Sodium chloride	27.213	pts. per 1,000 water.
Magnesium chloride	3.807	"
Magnesium sulphate	1.658	"
Calcium sulphate	1.260	"
Potassium sulphate	0.863	"
Calcium carbonate	0.123	"
Magnesium bromide	0.076	"

35.000

The term salinity as applied to the sea means the total weight of solid matter in grammes present in 1,000 grammes of sea water when (a) the bromine and iodine are regarded as replaced by chlorine, and (2) the carbonates are reduced to oxides and the organic matter ignited.

The average salinity of the sea may be taken as 35 per mille. The ocean water is remarkably uniform in composition in the different regions, varying from say 37.5 per mille to 34 per mille, but coastal waters are subject to greater fluctuations and so are polar seas. The greatest variations are found at the entrances to rivers and the brackish water species of our estuaries, the creatures of the mangrove swamps in the Hawkesbury and Port Hacking inlets, for example, must be capable of living in sea water that varies considerably in salt content.

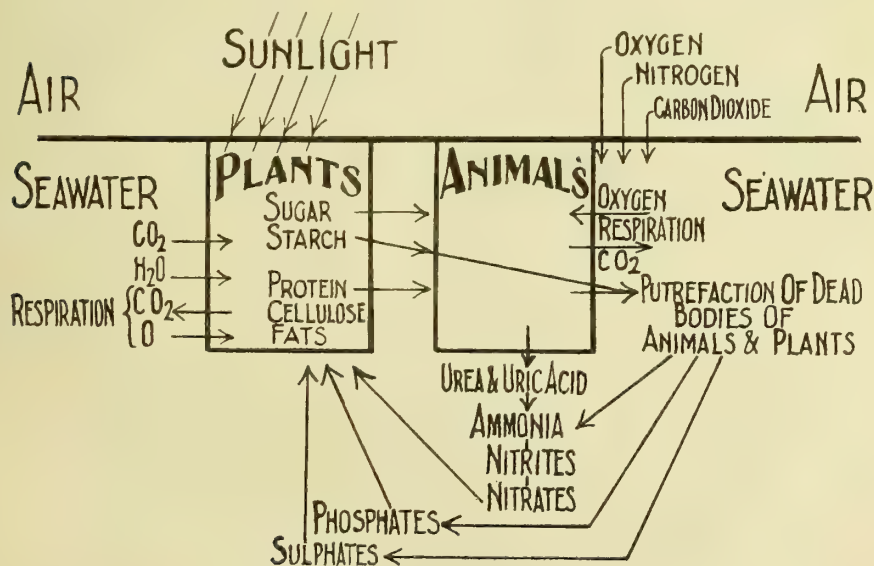


Fig. 2.

This saline fluid which is a vast nutrient medium for living creatures supports members of more different zoological groups than any other environment. The bulk of the salts are not necessarily food substances, and, though they enter into the composition of the tissues, they are far in excess of the amounts required. They not only exert a direct influence upon the aquatic life, but they influence to a certain extent the amount of oxygen and other gases present, for salt water has not the same dissolving powers as fresh water. It is the direct influence which I intend to discuss here. The creatures of the sea are living in a salt solution of considerable concentration, and their protoplasm is separated from this salt fluid by delicate membranes of diverse constitution. In the case of the single celled animals and plants the thin cell wall is the only partition. In the higher animals the cells of the body are bathed by an internal solution—the blood or the coelomic fluid—which is itself separated from the sea water outside by some sort of bounding membrane composed of cells. External to this there may be relatively impervious layers of skeletogenous tissue—like the exoskeleton of the crustacea, or the scales of the fishes. The skin of most aquatic vertebrates (with the exception of the amphibia which are not marine and are highly susceptible to salt water) is practically impermeable.

The chemical composition of the internal media—the blood for example—of the different marine animal types is characteristically diverse. In general, it may be said that as one approaches the higher groups there is a tendency for the development of constancy in the salinity of the blood, notwithstanding the presence of conditions which defy this.

Thus, to take man as an example of the mammalia, the salinity of the blood (which is approximately equivalent to a sodium chloride solution of 0.9 per cent.) is practically undisturbed by copious water drinking. The cells of the human body require a constant environment, and this is provided by the blood, which is regulated in an amazing manner in both temperature and chemical composition. It will be noticed, however, that the blood serum is a saline fluid. *Now the remarkable thing is that the blood salts present a curious similarity in their relative amounts to the composition of ocean water. It is shown in the following table:—*

Table showing relative amounts of principle ions in blood of various animal species and in sea water.

	Sodium.	Potassium.	Calcium.	Magnesium.	Chlorine.
Sea Water	100	3.613	3.911	12.106	180.9
M a m m a l s (average)	100	6.6	2.58	0.8	118.3
Cod.	100	9.5	3.93	1.41	149.7
Man.	100	9.2	3.37	1.76	101.4
Lobster	100	3.7	4.85	1.72	171.2

The similarity was first recognised by Bunge in 1889, and so far back as 1896-97, Quinton, a French physiologist, wrote several papers on the use of diluted sea water for injection into the blood vessels when serious loss of blood had occurred through wounds. The importance of the salinity is demonstrated in physiological laboratories every day, and if a student wishes to keep frog's muscle or nerve alive whilst he experiments with it, he keeps it moistened with a saline solution. Distilled water or fresh

water would be as deadly as fresh water is to a marine fish or an octopus. Thus the tissues of a frog living in fresh water, a reptile far from water, a bird no matter where, and a mammal, whether a whale or a man, require round them a salt solution (the blood), in which certain salts are present in very definite relations. It is no use replacing the solution by one of the same concentration, but of sodium chloride alone.

It is little wonder that Quinton (1), Bunge (2) and above all Macallum (3), regarded the salts of the human blood as a relic of the marine existence of some remote ancestor amongst the fishes. In fact, he considered that the saline composition of the blood of the higher vertebrates actually represented the salinity of the ocean at the time when their aquatic ancestor freed itself from the ocean's influence. In another place (4) I have set forth my objections to this view. Here I want to stress the importance of this saline fluid for living cells. Now the blood of the higher vertebrates is not likely to be affected by immersion of the animal in sea water or fresh water because the skin and bounding membranes of the body are as impermeable as a diver's costume. But it is quite another matter with aquatic animals like the amphibia, the fishes, and all the invertebrates. The fact that the oxygen for respiration is obtained from the water by these truly aquatic forms means that there is at least one membrane between the blood and the watery environment which is easily permeable by gases and is usually rather delicate. If, however, a permeable membrane is placed separating two aqueous solutions of different salinity, certain peculiar consequences may follow due to osmotic pressure and to other physical forces. If a piece of parchment or bladder is used to separate a 4 per cent. solution of sugar from a 1 per cent. solution of copper sulphate, water will be found to pass from the weak solution through the membrane to the stronger—the salt, however, will not pass through. A considerable osmotic pressure may be exerted by this water passing through. The bounding membranes of aquatic animals partake of the nature of the membrane abovementioned—they are said to be semi-permeable—permeable to water, but not to salts, or only with some difficulty permeable to salts. If, for example, the marine slug, *Onchidium*, from the Hawkesbury mangrove swamps is placed in fresh water, or diluted sea water, it begins to swell up and increase in weight, owing to the passage inwards of water. If, on the contrary, a specimen is placed in more concentrated sea water, the size and weight both diminish. Obviously the blood must change in composition as a result of any alteration in the salinity of the external environment, and it becomes a question whether the living tissues of the animal can withstand such change (7).

We have already seen that the cells of the higher animals demand a constancy in the salinity of the fluids bathing them. It thus becomes of interest to determine the effect of changes in the salinity of the watery environment of aquatic animals upon the internal fluids of the body. The analysis of the blood of the marine teleost fishes shows at once that in these vertebrates the salinity of the blood is very different from the concentration of sea water. In fact, the saline composition of the blood of these fishes is not unlike that of the mammalia, and it is obvious that the bounding membranes are either impermeable or that some regulation of the salinity is taking place. It is difficult to conceive of the gill membranes being altogether impermeable to water, and we must face the fact that a constancy of blood salinity has been attained; that it is essential, and that for some reason the optimum salinity which has been more or

less selected for these fish and all the higher animals is about one quarter that of ocean water.

The next step is to determine whether this blood salinity is absolutely constant notwithstanding changes in the external medium. One way to do this is to put a marine fish in fresh water or diluted sea water and see what happens. Probably death will result, unless certain species which can withstand such a change are taken for the experiment. In order to obviate the abnormal experimental conditions the author made a voyage from the North Sea to the Baltic Sea and sufficiently far into the latter to reach water of salinity only half that of the ocean (5). The same species of fish were captured at numerous stations en route and the osmotic pressure and salinity of the blood carefully determined. It was discovered that the salinity of the blood was affected by changes in the salinity of the sea, but the regulation of the blood composition was such that an increase of 75 per cent. in the osmotic pressure of the sea water was only accompanied by a change of 12 per cent.*

We may conclude that the blood of the teleost fishes is almost, but not quite, independent of the external medium; that this independence is due to some kind of regulation, and that these fishes are very sensitive to changes in the salinity of the external medium. The sensitivity is probably centred at any of the delicate semi-permeable membranes, the gills, for example, where regulatory functions may be taking place. Such sensitivity is demonstrated, not only by the restriction of most fish to either salt or fresh water, but by the directive influences of slight changes in salinity, which are without doubt utilised by species which regularly migrate from the sea to brackish water and vice versa. In addition to the examples previously mentioned, reference should certainly be made to the herring fisheries of the Baltic, which fluctuate considerably because certain races of herring refuse to go into water of less salinity than 33 parts per thousand. A recognition of a change in salinity of three parts per thousand is worthy of note. It is of special interest when we take into consideration the probability that a teleost is constantly expending some energy in the regulation of its internal salinity.

The matter does not end with the adult. The teleosts set free their eggs and spermatozoa into the sea and fertilisation of the eggs takes place in the sea water. Osmotic pressure determinations made by the author (6) show that the salinity of the egg contents of the plaice like that of other body tissues is much less than sea water. There is no reason to doubt that the salinity of the secretions of the male gonad is very different from the blood. So the reproductive cells are set free from a relatively dilute medium into a concentrated sea water. Notwithstanding this, the egg contents retain their low salinity, but only so long as the egg membrane is a living one. And this depends amongst other things upon the chances of fertilisation. If within a limited number of hours, the latter does not take place death ensues, the egg contents become more saline (by diffusion of salts inwards or of water outwards), and the egg sinks to the bottom. As a matter of fact, the pelagic eggs won't float at all unless the water is of a certain salinity and specific gravity. In consequence of the egg contents taking the same salinity as the body fluids of the adult, and that being considerably less than sea water, we have here

* For details of the methods employed, see papers quoted in bibliography.

one, but not the only explanation, of the fact that the eggs of fresh water teleosts are demersal, whilst many marine teleosts, possibly most, have pelagic eggs.

A reduction in the salinity of the sea water in which developing pelagic eggs are floating can cause them to sink to the bottom—the results could be favourable or unfavourable.

Investigation of the elasmobranchii shows that the osmotic pressure and constitution of the blood of sharks and rays is outstandingly different from that of the teleosts. In fact, the blood of the sharks and rays is fundamentally different in constitution from that of all other vertebrates. If we measure the osmotic pressure of the blood of a shark living in the Pacific Ocean, it is found to be approximately the same as that of the ocean water. Moreover, considerable variations in the salinity of the sea water are followed by identical variations in the osmotic pressure of the blood. It is very evident that the blood of the sharks and rays is greatly influenced by the composition of the sea water. One might imagine that the blood of these animals was of the same salinity as the water bathing their bodies; chemical analysis shows, however, that the explanation of the high osmotic pressure is very different. The blood may contain over 2 per cent. of urea, and it is the extraordinary quantity of this substance which, with the salts, balances the salinity of the external medium. In order to keep alive isolated tissues from a shark, they must be moistened with a suitable saline medium containing about 2 per cent. of urea.

Possibly these conditions have some bearing upon the present distribution of the elasmobranchii and maybe they evolved in water of much lower salinity. This might explain also the invasion of brackish waters by certain species of sharks at the egg laying season. A dilute sea water would certainly approximate more to the salinity of the blood.

We may now turn to the invertebrates, a motley assemblage of phyla in which the marine forms present some fundamental differences from the vertebrates in their relations with the environment. In the first place the internal fluids of marine invertebrates have almost the same osmotic pressure as that of the surrounding sea water. This carries with it the implication that if the sea water varies in osmotic pressure, corresponding changes must take place in the blood or else the animal succumbs. The osmotic pressure is due almost entirely to salts, and this means that in most marine invertebrates the blood and other internal fluids of the body are as saline as the sea itself. But notwithstanding this, and in contrast to the approximation to equality in salt contents and osmotic pressure, the proportion of the different salts (or their ions) one to another is not quite the same as in the sea—the difference is particularly marked in the higher crustacea. Thus the blood of the mangrove crab, *Heloecius cordiformis*, which scuttles about the Hawkesbury mangrove flats in thousands is very responsive to changes in the salinity of the environment, and its bounding membranes are permeable to both water and salts. If the water became very highly concentrated indeed by evaporation under a hot summer sun, *Heloecius* would be able to stand it, although its blood salinity might increase 50 per cent. But dilute the sea water with fresh water and a concentration is soon reached beyond which no further fall will take place in the blood. These crabs will withstand water which is two-thirds fresh and one-third sea water for long periods, but the animals in some way retain a high salinity in their blood. They now resemble the fresh water crayfish and probably all fresh water crustacea. They carry

with them a certificate of a marine existence. Apparently there is nothing about this regulation or control of salinity in the fresh water crustacea which is absent from species confined entirely to the sea. The difference lies in the fact that the tissues of some marine animals will still function in contact with a blood which has been considerably reduced in salt contents—they are able to invade fresh water or to exist in areas of the sea which have been converted into lakes. Others are extraordinarily sensitive to these changes in blood salinity, especially when made rapidly. They will be seriously affected by changes in the external medium. We have clear evidence that the world of living things has had a very long experience of a salt sea, and it is altogether probable that it was the original source of life on this earth. The restriction of cuttlefishes and echinoderms to sea water must be entirely a matter of salinity. These are extreme cases of restriction, but limitations of all grades occur.

No one has yet discovered the mechanism which accounts for the retention of the salts in the blood of the fresh water crustacea, but we still know very little of the forces controlling diffusion through any living animal membranes.

Our studies on salinity bring us face to face with physiological problems of great complexity, and yet this physical factor in the aquatic environment is only one of those we have tabulated in Fig. 1. In the higher animals, the tissues live in a fluid, the blood, which is wonderfully constant in composition, which carries food substances and oxygen, is the vehicle for the transport of waste substances, and the distribution of hormonal messengers. For a great diversity of marine invertebrates the sea water is almost the equivalent of that remarkable fluid, and its constancy in composition is worthy of note.

Factors Determining the Productivity and Migrations of the Tiger Flathead.

I have, with set intention, traced the study of the ocean's tangled story—a romance involving the origin of life at one end, and the composition of the human blood at the other—for the purpose of coming eventually to industry and human affairs.

Now with the aid of a "common" sea creature I shall try and emphasise the complexity of marine studies when all the fundamentals are unknown.

The Tiger Flathead is the most important constituent of the trawler catches on the New South Wales coast. We have seen that the productivity of coastal waters depends in the very first case on the physico-chemical conditions of this region, and all the factors indicated in Figs. 1 and 2 and concerned in the production of a good yield of plankton must thus be taken into account. Beyond this, the food of every stage in the life of the flathead from the tiny newly hatched fish to the mature adult must be present in sufficient amount at the right time and place; so, one of the first needs is to follow out the life history of the flathead. Its breeding places must be discovered and the physico-chemical or biological factors which are preferred.

Some attempt must be made to ascertain the productivity of the fishing banks by determining the age of the fish caught, and whether there is a decreased capture of the older age groups of large sized fish, or a diminished total yield per hour of fishing as the years pass by. Eventually we shall have to analyse the changing composition of the fish itself through the seasons.

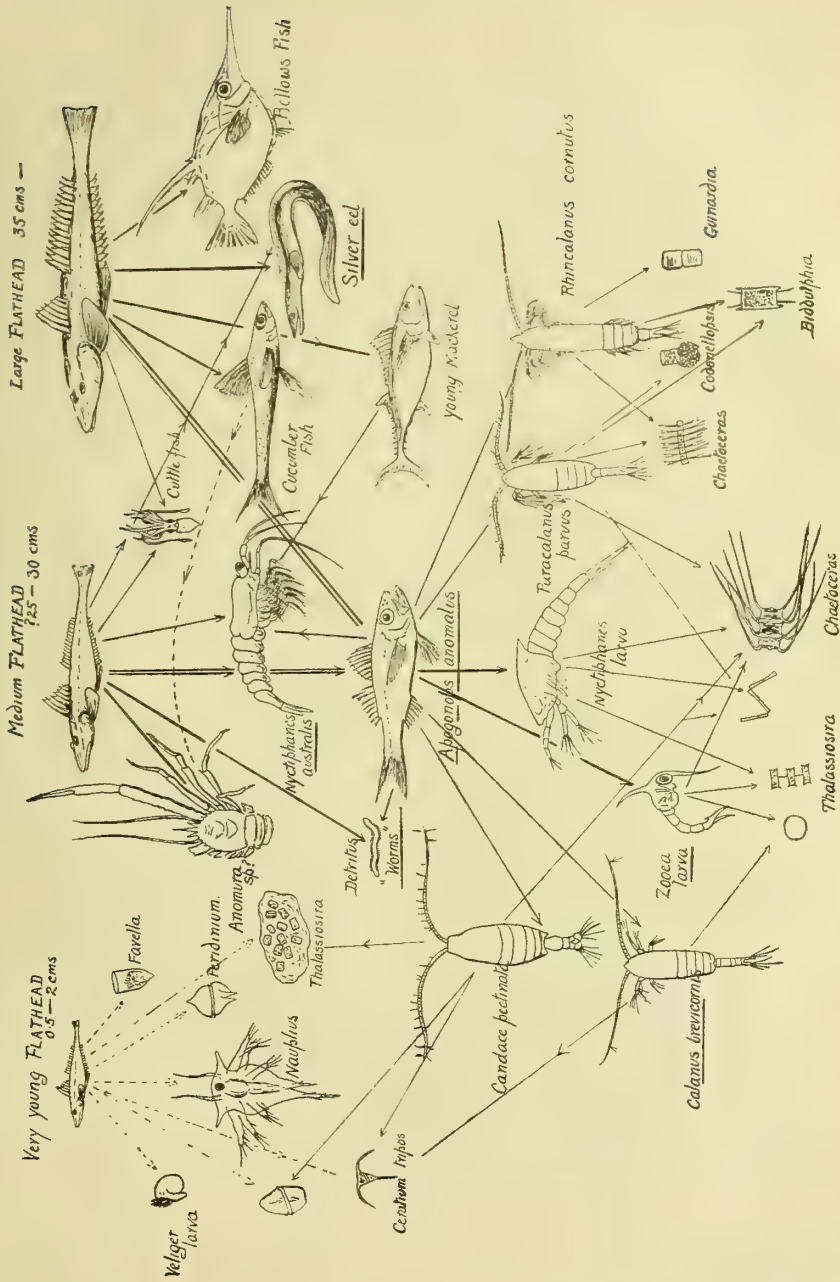


Fig. 3. Food chain of the Tiger Flathead.

The illustration (Fig. 3) gives some idea of our first attempts to gain an insight into the relationships of the Tiger Flathead.*

A glance at the diagram will show what an amazing series of interwoven existences determines the life of this fish. It is by no means a sluggish bottom fish. It has even surprised us by its activity and its wanderings, and it will naturally move where suitable food is most plentiful. Its food in the more adult stages is rather varied and our diagram by no means indicates all its captures nor exhausts its possibilities. The most regular food supplies concern us more than the chance meals.

This "food" will, of necessity, move after its "food," and so on down the chain. It is the old story of "Je mange—je suis mangé," until we reach the world of the minute but numberless. Then comes simple mineral matter. Hence the paramount need of a complete study of the oceanography and biology of Australian waters if we wish to conserve our fisheries. Compared with this, the discovery of new fishing grounds is easy, but it is scarcely the work for scientists, although scientific forecasts of the quality of herrings in the North Sea are being made before their season is due, and attempts to estimate the likelihood of finding fish before shooting a net. The dire need here at the present time is some knowledge of the basal principles which underlie a rational regulation and exploitation of the industry. To regulate and restrict without knowledge is as futile in the end as the attainment of great captures with no information about the possibility of their continuity. The sea is not an inexhaustible welter of life. The story of northern and southern whaling and the history of North Sea fishing is a sufficient indication of that.

Trawlers are compelled to go further afield and must venture their nets in almost impossible depths and places. But there is a limit to this, and the courage and perseverance of the fishers is bounded by the "laws" of economic supply of the peoples' foodstuffs, and by the restriction of large quantities of fish life to the shallower seas where only the conditions are favourable.

The present New South Wales grounds all added together are only equal to about two-thirds of the Irish Sea—the area of water between Ireland and England—and this from the point of view of steam trawling is nothing more than a huge lake. Discussions are frequent in Europe on the impoverishment of the Irish Sea and North Sea owing to the enormous fishing. Well, we have removed from our coastal area, in one year by trawling alone, four times the catch that the Irish Sea has provided in the same time with its far more boats and men. In 1927, 10,763,600 lb. of fish were trawled from the New South Wales waters, to say nothing of the huge estuarine catch.

It is difficult to make comparisons of productivity from the statistics available, but we find that the average trawlers catch per day's actual fishing off our coast during 1930 was just under 30 cwt. The average catch of a British 1st class steam trawler per day's absence in the North Sea is given for 1920 (an excellent year because of the war years stopping

* I am indebted to Mr. Allan Colefax, B.Sc., who has ably carried out under my direction the investigation supplying most of the data concerning the flathead's food and collected the statistics on board New South Wales trawlers. My thanks are due also to the Commonwealth Council of Scientific and Industrial Research for their financial aid and the Red Funnel Fisheries for their very ready help and hospitality on board their trawlers.

fishing) as 24 cwt. This means, of course, more, per actual day's fishing, but then a British trawler will probably have the nets down for 16 hours per day. Distant fishing grounds like the Iceland waters give the maximum of 50 cwt. per day's absence from port (say 70 cwt. per day's fishing of 16 hours).

The hake trawlers 100-250 fathoms off the west coast of Ireland regard 170 cwt. of fish in 100 hours actual fishing time as good fishing and enough to make a big trawler pay. This is equivalent to 17 cwt. in 10 hours, compared with our 30 cwt. in the same time, but hake is a valuable fish and the capture of other fish with the hake might make up the profits. We may, I think, take it that our yields are pretty much the same as those of the North Sea to-day. Will they remain the same?

Unfortunately, owing to the lack of detailed statistical information, it is not possible with exactness to picture what has been happening on our grounds. One or two facts are interesting.

In 1910, Dannevig, in the second report of the "Endeavour" experiments, estimated that a trawler in the Eden district would be able to land 18½ tons of marketable fish and 35 tons of offal and unmarketable fish per week of 60 hours' fishing; that is to say, well over 60 cwt. of food fish per day's fishing of ten hours. In another place he gives 2-1/6th tons of fish per day. Either Dannevig was extraordinarily optimistic, or the catches were far better in those first years of trawling. As a matter of fact, I think his own tables show a much lower average. The evidence of the trawlers is that there has been a distinct falling off in the catches during the last three years, a reduction per hour's fishing. A reduction in the captures by the trawlers per hour's fishing by no means implies that overfishing has taken place. There are curious ups and downs in the abundance of animal species, and remarkable series of changes have been noted in the sea. Different types of American and European fishes have fluctuated, quite apart from fishing, when considered over a period of 200 years.

One indication of reduction of fish by overfishing is a diminution in the size of those caught. Unfortunately, no attempts had been made (until we commenced this last year) to collect size statistics. The usefulness of the fish is a measure of its size, and destruction of fish which have never reached the size correlated with sexual maturity means waste.

Now a knowledge of the size of large numbers of fish caught is useful in another way. There is a relation between the length of a fish and its age. A knowledge of the age supplies information about the rate of growth and also about the years which were good breeding years. It has been found, for example, by examining large numbers of the herring of European seas that the ages of the fish composing the shoals vary considerably, but certain aged fish are far more abundant than others. The fact that the next year these same groups may be represented, but a year older makes it likely that there were "good and bad years" in the past when the fish were hatched (good vintage years we might say). Indeed, the influence of a good year may be marked for many years. The 1904 brood of herrings formed the bulk of all the herrings caught in the years 1908-1911. Something happened in the good year that did not happen in a poor year. Devastating losses amongst eggs and tiny larvae may easily follow unfortunate coincidences of hydrographic conditions and hatching seasons. The same thing is with every certainty true of our own fish.

Now there are several ways of determining the age of fish. One of these is by scale readings; another is by length statistics. A fish scale

grows by successive additions of material and a series of somewhat concentric lines indicate these accretions. A number of photographs of scales are given in Plate II. Most fish so far examined come from the northern hemisphere, where there is a marked difference in summer and winter sea temperatures. The growth of fish is slowed down considerably in winter, and, as a result, the rings on the scales are closer together then. The result is a series of bands—so-called growth rings—which correspond with the successive seasons. We need not go into the matter here. Suffice it to say that many of our fish present unfortunate examples. Possibly it is due to the equable temperature of the New South Wales waters favouring very uniform growth rates, but whatever be the cause there are few irregularities on the scales.

I have examined the scales of a large number of species of the New South Wales food fishes, but it was interesting that the first scales discovered to show what may be regarded as seasonal markings came from Hobart—the Tasmanian Trumpeter and the Jackass Fish. Most scales have, however, been obtained from the flathead, and there is a possibility that after some study, scale reading may prove practicable for this species. Two scales are shown in Plate II., which differ by the presence in one, of two, and in the other, of three "rings." The two-ringed scale came from a fish 25 centimetres long, and the three-ringed scale from a 31 centimetre fish. We still have to determine by the examination of far greater numbers of scales whether there is consistency in this and what is the age indicated by the first ring.

Uncertainty in scale readings, for one thing, and the intention of determining growth rates, etc., has led us to pursue more extensively the method of length statistics.

This is based on the assumption that where the breeding season of a particular species is limited to one season of the year (say 2 or 3 months) all the fish of that kind captured must fall into age groups differing by say 9-14 months, but with an average difference of one year. If now the rate of growth is the same for all individuals (and if thousands of fish are measured exceptional individuals are balanced out), a curve depicting lengths should be a many peaked curve, each peak representing a yearly age group.

Mr. Colefax has measured at sea 35,000 flathead. A rough result is depicted in Fig. 4; full details of these results will be given in his paper.

We have sufficient results now to indicate that the collection of length statistics is going to be just as valuable in assessing the age and growth of the flathead as in the corresponding applications to cod and herring. The curve shows distinct peaks at four points, and there is no doubt whatever in our minds that this represents four distinct and successive ages. The unknown at present, however, is the age of the first length group. There is a gap in our knowledge owing to the scarcity of very small flathead captured, and by very small I mean the sizes between hatching and say 14 centimetres. Another point of interest which is not shown in the curves is that the contents of a catch tend to fall into one age group. These results will be of greater value in the future. Meanwhile, an interesting feature of them is the evidence that the flathead tend to associate in age groups as they migrate in shoals about the sea bottom. The shoals do not remain in the same place, although there seems to be a tendency for very small fish to be taken in shallow water and big fish in deeper water, apart from movements associated with the breeding season. Unfortunately, it is necessary to obtain the data from the ordinary fishing grounds, and we

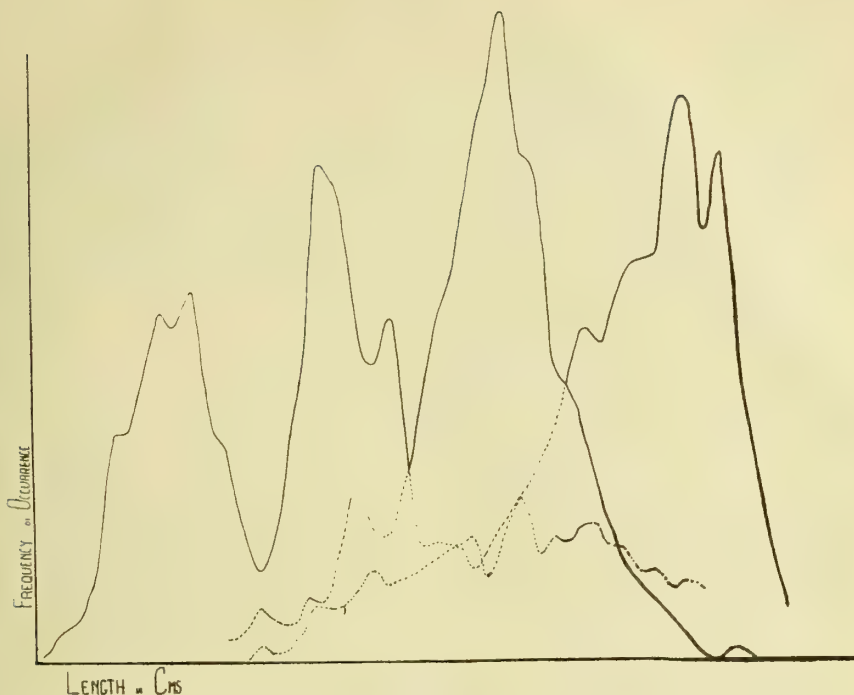


Fig. 4.

badly need figures for very deep water and for very shallow water, the latter especially to fill in our series.

If we turn for a moment to Fig. 3 again, it will be seen that one of the most important foods of the adult flathead is the small fish *Apogonops anomalus*. This creature seems to live very largely on minute crustacea. The crustacea are, however, planktonic; they appear in different places in abundance at different times, and, moreover, they mount towards the surface of the sea at night. This diurnal rise and fall of huge quantities of planktonic animals is very remarkable. A minute crustacean, the size of a pin head, may rise from 30 fathoms at the rate of 1 foot per minute. We have abundant reasons here for the wanderings of the flathead, and confirmation is supplied again by the fact that night catches of the trawlers are often poor, where the day catches had been good. There seems to be only one explanation of this, and that is a vertical movement of the flathead up off the sea bottom. A rise of only 15 feet would remove them from all possibility of capture by the trawl. It is even conceivable that the fish feeds little by day, and is relatively inactive and on the bottom (cf. Hickling's sleep rhythm of the Hake (8)).

I have no doubt that a series of investigations of the bottom fauna and the plankton would enable us to demonstrate pretty close relationships between the abundance of flathead and the richness of some item in

the food chain. But we have only just touched the outermost fringes of a vast subject, and with our own special difficulties correlated with these seas.

I have no doubt that many folk with money invested in the fisheries have no interest whatever in scientific research. I am equally certain that their first attitude to scientific investigation would be to ask for directions as to where most fish could be caught. If the question could be speedily answered, it would probably only result in a glut of fish and considerable wasteful destruction. The problem for the scientist is not merely how to get most out of the sea, but how to continue doing so, and how to make the best use of the products. Possibly one of these days we may learn to farm the sea. At the present time, as the old North Sea Shanty has it:—

"The farmer has his rent to pay,
Haul, you Joskins, haul!
And seed to buy, I've heard him say;
Haul, you Joskins haul!
But we who plough the North Sea deep,
Though never sowing, always reap
The harvest that to all is free;
And Gorleston Light is home to me.
Haul, you Joskins, haul!"

I hope those interested in all scientific investigation will realise how impossibly slow is our chance compared with what is essential. We spend £100 where the United States, or England, or Japan spends £50,000, and that £100 is only equivalent to £50 in those countries. And the Cinderella science in Australia from the school life to the University is biology. It is customary to grumble that our statesmen refuse the minimum equipment which would enable us to solve some of the problems, but the blame is not all to be saddled on the politicians. As Howell put it, "They are, after all, laymen." And very little attempt has been made in Australia to enlighten the public generally on the importance of biological studies and in the case at issue, in the proper appreciation of marine research.

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EXPLANATION OF PLATE II.

Scales from Australian fishes (magnified approximately four times).

- Fig. 1. Scale from Tiger Flathead (*Neoplatycephalus macrodon* Ogilby),
25 centimetres in length.
.. 2. Scale from Tiger Flathead (*N. macrodon*), 31 centimetres in
length.
.. 3. Scale from Snapper (*Pagrosomus auratus*).
.. 4. Scale from Tailer (*Pomatomus saltator*).
.. 5. Scale from Tasmanian Trumpeter (*Latris lineata*).
.. 6. Scale from Blackfish (*Girella tricuspidata*).

AUSTRALIAN CISTELIDAE—CORRIGENDA.

In my Check List of the Australian Cistelidae [Aust. Zool., 1930, p. 270]
an omission of two genera makes the following revised table of Group ii.
necessary:—

- | | |
|--|-------------------------|
| 1. With wings adapted for flight | 2. |
| Without such—at least in the ♀ | 11. |
| 2. Mandibles grooved, scarcely bifid at apex | <i>Dimorphochilus</i> . |
| Mandibles distinctly bifid at apex | 3. |
| 3. Hind femora extending well beyond elytra when at right angles to
suture | 4. |
| Hind femora not so | 9. |
| 4. Elytra striate-punctate (strial punctures distinct from inter-
stitial) | 5. |
| Elytra striate (strial punctures not distinct from interstitial) | <i>Barycistela</i> . |
| 5. Antennal segments slender, more or less linear | 6. |
| Antennal segments stout, more or less obconic | 7. |
| 6. Eyes smaller, in general widely separated | <i>Homotrysis</i> |
| Eyes larger, approximate in ♂ | <i>Hybrenia</i> . |
| 7. Prothorax short and transverse | 8. |
| Prothorax subcordate | <i>Iophon</i> . |
| 8. Pronotum strongly foveate, elytra obovate | <i>Nypsius</i> . |
| Pronotum not so, elytra subcylindric | <i>Ommatophorus</i> . |
| 9. Form widely ovate | <i>Nocar</i> . |
| Form oblong ovate | 10. |
| 10. Surface convex, antennae very short, widened towards apex. | <i>Taxes</i> . |
| Surface subdepressed, antennae longer, scarcely widened at apex | <i>Scaletomerus</i> . |
| 11. Epipleurae wide (facies of <i>Otiorrhyncus</i>) | <i>Simarus</i> . |
| Epipleurae narrow | 12. |
| 12. Prothorax more or less ovate, elytra striate-punctate | 13. |
| Prothorax cordate, elytra tuberculate | <i>Notocistela</i> . |
| 13. Epipleurae separated from elytra by carina | <i>Metistete</i> |
| Epipleurae and elytra subcontinuous, without separating carina | <i>Melaps</i> . |

H. J. CARTER.

THE BEES OF AUSTRALIA.

By T. D. A. COCKERELL.

(Continued from vol. vi., part iii., p. 236.)

ANTHOPHORIDAE.

These swift-flying long-tongued bees are widely spread over the earth, but are wholly absent from New Zealand and many oceanic islands. In Australia the species are comparatively few, and pertain to only two genera. It was formerly supposed that the genus *Tetralonia* Spinola existed in Australia (*T. brevicornis* Smith and *T. convicta* Ckll.), but it turns out that these are actually forms of *Paracolletes* with unusually long antennae. The mouth-parts are quite unlike those of the *Anthophoridae*.

The two genera of Australian *Anthophoridae* are separable thus:—

Labial palpi two-jointed, with a brush of stiff hairs at the end; maxillary palpi six-jointed; abdomen never with blue or green bands

Asaropoda Cockerell.

Labial palpi four-jointed; maxillary palpi six-jointed; abdomen in many species with metallic or brightly coloured bands . . *Anthophora* Latreille.

Although *Anthophora* is abundant in both hemispheres, while *Asaropoda* is confined to Australia and New Guinea, the latter is not a primitive genus, but has undoubtedly been derived from *Anthophora* or a close relative. *Asaropoda* was confused with the European *Saropoda* Latreille, which, however, has four-jointed maxillary palpi. It must be stated that the mouth-parts have been examined only in the type-species of *Asaropoda*, *A. bombiformis*. The other two are referred here, because they appear to be closely allied.

ASAROPODA Cockerell.*Asaropoda bombiformis* (Smith).

A rather large robust red-haired bee, with a conspicuous broad black band at base of second tergite. The legs are largely red, and the scape is red or yellow in front; the clypeus is without dark markings (except a slender black line along each lateral suture above) in both sexes. Victoria to Queensland. Also Binaturi River in New Guinea. A new locality is Montville, Queensland. (C. Borch).

Asaropoda alpha (Cockerell).

Male; differs from *A. bombiformis* by its smaller size (length less than 12 mm.); hair on hind tarsi entirely black, except a small orange tuft at base above; lateral margins of clypeus with a rather broad black band; flagellum ferruginous beneath, except base of first joint; legs dark, but covered above with orange hair; beneath with black, except that the tarsi are as just described; the bidentate apex of abdomen covered with black hair (fulvous in *A. bombiformis*). Described from a specimen in British Museum, labelled Australia, and recorded by F. Smith as a variety of *A. bombiformis*.

Asaropoda anomala Cockerell.

Male; appearing exactly like *A. bombiformis*, with broad bare black band at base of second tergite, but easily distinguished by the third antennal joint, which is short and thick (instead of being long and slender), and by the longer flagellum, its length fully 5.5 mm. (instead of about 4). Femora clear red, the posterior ones a little dusky beneath at base. The apex of abdomen is obtusely bilobed (without the distinct angles of *A.*

bombiformis.) The female is like *A. bombiformis*, but rather larger and more robust. Hair-bands of second and third tergites broad, the anterior half greenish; hair of fourth and fifth tergites greenish, with a beautiful golden lustre. Brisbane. In American Museum of Natural History. (Amer. Mus. Novitates, 346, pp. 15-16.)

Friese (Deutsch. Ent. Zeitschr., 1911, p. 448) described *Anthophora flava* from a female taken at Freemantle, W. Australia. He said it was very like *A. bombiformis* (with tegument of abdomen black under the hair), but thickly covered with yellow hair; even the abdomen on tergites 2 and 3. Clypeus and labrum yellow, mandibles yellow, legs yellowish, tegulae yellow. He also described *Anthophora rufescens* as related to (or similar to) *A. bombiformis*, but this is evidently very close to *Anthophora rhodoscymna* Ckll.

ANTHOPHORA Latreille.

There are two groups of species, the first of which is more characteristically Australian, while the second is spread over the tropics of the Old World, and presumably reached Australia in comparatively recent times.

Abdomen not, or not obviously banded; covered with appressed hair. Group 1.
Abdomen conspicuously banded, the bands usually brightly coloured. Group 2.

GROUP 1.

Covered with short green or greenish pubescence, sometimes strongly reddish on abdomen in males; legs always with some bright emerald green hair; clypeus of male orange, with a small black bar on each side above, of female with a large black mark on each side, the pale area coming to a point above

. *aeruginosa* Smith.

Covered with mouse-grey hair *preissi* Cockerell.

Appressed hair of abdomen fulvous 1.

1. Tegument of abdomen black, except broad hind margins of segments; clypeus of female yellow, with two large brown patches; tegulae clear testaceous *scymna* Gribodo.

Tegument of abdomen red; clypeus in both sexes with a reversed T in yellow; female 16.5 mm. long, with no supraclypeal or lateral face-marks; tegument of abdomen above entirely bright ferruginous. *rhodoscymna* Cockerell.

Resembling *A. rhodoscymna*, but with a large black spot on disc of second tergite; length, 13-14 mm.; tegulae yellowish *rufescens* Friese.

Anthophora aeruginosa Smith.

A very distinct and easily recognised species, found from Hunter River, N.S.W., to Northern Queensland and Port Darwin.

Anthophora preissi Cockerell.

Discovered by Preiss in Western Australia; type in Berlin Museum. There is in addition a race *A. preissi froggatti* Cockerell, found by Froggatt at Brewarrina, N.S.W. The female of this form is about 16 mm. long, with the same mouse-coloured hair, but has the antennae black, flagellum not red beneath; a transverse yellow supraclypeal band, and lower corners of

clypeus broadly pale yellow; median pale stripe on clypeus narrow, not tapering above. Female of typical *A. preissi* is about 15 mm. long.

Anthophora rhodoscymna Cockerell.

Male about 12.5-13 mm. long, female about 16.5. Discovered by Gilbert Turner in the Mackay district of Queensland, but extending south to Brisbane. The type is in the British Museum.

Anthophora rufescens Friese.

Described in 1911, from a specimen taken by Turner at Mackay. It may prove to be a variety of *A. rhodoscymna*.

Anthophora scymna Gribodo.

Reported from Adelaide, West Australia and Queensland. A specimen in the British Museum was obtained by Du Boulay at Champion Bay, W. Australia, in 1866-67.

GROUP 2.

- Abdominal bands pale lilac, the first two in the male suffused with ochreous; fifth ventral segment of male with a deep broad rounded emargination *lilacina* Cockerell.
- Abdominal bands not lilac 1.
1. Clypeus light, with a black stripe on each side of upper part; males 2.
- Clypeus with at least large black marks 4.
2. Larger, about 13 mm. long; hair of thorax above bright orange-fulvous, with black intermixed; abdominal bands bright blue.
- *cingulata* Fabricius (var. *gilberti* Ckll.)
- Smaller; abdominal bands greenish or ochreous or pallid. 3.
3. Hair of thorax above bright orange-fulvous, with black intermixed; abdominal bands emerald green shading to blue
- *cingulata* Fabricius (*emendata* Smith.)
- Hair of thorax above ochreous or light fulvous, with black intermixed; abdominal bands very light bluish or greenish
- *zonata* Linnaeus (*pulchra* Smith.)
- Looking like *A. zonata* (*pulchra*), but with conspicuous black hairs on vertex and front, broader face, deeply emarginate fifth ventral segment, and entirely black-haired hind tarsi . . *asserta* Cockerell.*
4. Males 5.
- Females; size larger; clypeus with a light reversed T., its stem tapering above, pointed 7.
5. Sides of clypeus broadly black, leaving a light pyramid, which is notched on each side; abdominal bands dull white; length about 11 mm.
- *salteri* Cockerell.
- Clypeus yellow, with a large foot-shaped mark, with a very long heel,

* Since writing the above, I have examined two pairs of *Anthophora* sent by F. Erasmus Wilson, and find that there are complications yet to be dealt with. They come from Redcliffs, Victoria (*L. H. Chandler*) and Blackall, Queensland (*C. Borch*). In both males the clypeus is broad above, the straight upper margin of the yellow much longer than the distance from its ends to the orbits. In a male *A. zonata* from Thursday Island, the upper edge of the yellow is much shorter than the distance from its ends to the orbits. I am calling all Mr. Wilson's specimens *A. zonata*, but I now feel that the value and significance of the names *zonata*, *pulchra* *asserta* need reconsideration, and would urge Australian students to dissect specimens from as many localities as possible.

- on each side above; abdomen with bright shining blue bands, with no tinge of green *darwini* Cockerell.
 Clypeus with a large reversed T. in yellow, its stem broadly truncate on upper margin 6.
 6. Length about 10 mm.; hair of mesothorax light blue mixed with black; abdominal bands largely green *walkeri* Cockerell.
 Length about 11 mm.; hair of mesothorax yellow mixed with black; abdominal bands light yellowish, with a sort of greenish tint *adelaidae* Cockerell.
 7. Hair of mesothorax light greenish mixed with black; light hair on outer side of middle legs strongly suffused with blue; abdominal bands light blue *chlorocyanea* Cockerell.
 Hair of mesothorax light blue mixed with black; abdominal bands very bright greenish-blue *walkeri* Cockerell.
 Hair of mesothorax very bright orange-fulvous mixed with black; light hair on outer side of hind legs orange-fulvous; larger than the next species *cingulata* Fabricius (var. *giberti* Ckll.)
 Hair of mesothorax paler fulvous, inclining to greenish and mixed with black; light hair on outer side of hind legs white
 *zonata* Linnaeus (*pulchra* Smith.)
 Length nearly 13 mm.; hair of thorax above pale fulvous mixed with black; abdomen with four light blue bands, fifth tergite with a tuft of white hair in middle and much white hair at sides; hind basitarsus with a tuft of white hair at base; flagellum dark. Abdominal bands narrower and bluer than in *A. chlorocyanea*.
 *asserta* Cockerell.

Anthophora adelaidae Cockerell.

Described from a male in the British Museum, collected by J. J. Walker on the Adelaide River, N. Australia. There are several specimens in the Hope Museum at Oxford.

Anthophora asserta Cockerell.

Described in Ann. Mag. Nat. Hist., August, 1926, from specimens in the National Museum of Victoria. Males from Lower Fern Tree Gully, Victoria; female from Canterbury.

Anthophora chlorocyanea Cockerell.

This is the species which was formerly mistaken for *A. cingulata*. South Australia.

Anthophora cinctofemorata Sichel.

Published by Dours in his Monograph of *Anthophora* (1869). It is based on a male from "New Holland," 9 mm. long, without head (which was missing in type); anterior wing 7 mm.; thorax and legs with silvery hair; abdomen black, very strongly punctured; tergites 3 to 6 with blue (somewhat greenish) bands; wings dusky. I have never seen a specimen. Owing to the loss of the head, it cannot be placed in the table.

Anthophora cingulata Fabricius.

This is *A. emendata* Smith, but Meade-Waldo found that it was the real *cingulata*. The larger, very richly coloured form from the Mackay district, which I named *giberti*, may perhaps be a valid race. The typical (*emendata*) form is also from Queensland. For a further discussion, see

Ann. Mag. Nat. Hist., October, 1905, p. 396; but Meade-Waldo states that the type of *A. emendata* is a male, not a female, as stated by Smith.

Anthophora darwini Cockerell.

Discovered by Turner at Port Darwin; type in British Museum.

Anthophora lilacina Cockerell.

Discovered by Dodd at Kuranda, Queensland. Type in Queensland Museum.

Anthophora salteri Cockerell.

Parramatta and Sydney, N.S.W., the type found by W. R. Salter, and now in British Museum.

Anthophora walkeri Cockerell.

Found by J. J. Walker on the "Penguin" Expedition, on Baudin Island, Long Reef, W. Australia. Type in British Museum.

Anthophora zonata (Linnaeus).

Widely distributed in Queensland, and extending to Adelaide, S.A., and W. Australia. A colour variation has been referred to as *A. zonata subcaerulea*, but it appears not to be the genuine (Asiatic) *A. subcaerulea* of Lepeletier, for the characters of which see Ann. Mag. Nat. Hist., May, 1911, p. 492. It is possible that more intensive studies may indicate the separation of the Australian insect from *A. zonata*, in which case it will take the name *A. pulchra* Smith. Smith described *A. pulchra* from Cape Upstart, Moreton Bay and Hunter River.

NOMADIDAE.

Parasitic bees related to the *Anthophoridae*, and, indeed, placed in that family by Perkins (1919), where *Nomada* is recognised by the absence of a pollen-collecting scopa, and the marginal cell pointed at the apex. However, *Nomada* differs from the *Anthophoridae* (except *Melitoma*) by the absence of the outer comb of the maxillae; the inner comb is also lacking, as in *Melitoma* and many diverse genera. I have considered *Nomada* to be derived from an ancestor allied to the *Panurgidae*, but it is now an isolated genus. There are three cubital cells in the anterior wings; marginal cell pointed on costa; maxillary palpi six-jointed; general appearance usually wasp-like, with ferruginous or yellow markings. The species are generally parasitic in the nests of *Andrena*, which does not occur in Australia, but many are undoubtedly associated with *Halictus*.

There are some species of *Nomada* which have only two cubital cells. This is the case with *N. (Heminomada) oblitterata* Cresson, of North America, but it is not constant, some specimens being found with three cubital cells. Robertson found about 25 per cent. of his specimens, collected in Illinois, had the three cells. Thus we see within the species the stages in the production of a condition which is characteristic of the *Panurgidae*. The Indian *Lamproapis* Cameron, supposed to be allied to *Dufourea*, is a *Nomada*, with two cubital cells, as I have been able to ascertain from a specimen received from the British Museum, collected at Simla. The species will stand as *Nomada maculipennis* Cameron.

NOMADA Fabricius.

Nomada australensis Perkins.

This was taken at Cairns by Turner and Dodd, and at Mackay by

Turner. There are six specimens in the British Museum, where there is also a specimen of an undescribed species from New Guinea. The female *N. australensis* is 6 mm. long; the size of the male is not stated, but is presumably about the same. The male has the head and thorax black or nearly so; mandibles, cheeks, labrum, clypeus, a narrow line along inner orbits reaching the vertex, antennae beneath, scutellum and postscutellum pale yellowish brown; abdomen dark or blackish brown, more or less paler at the articulations of the segments; second tergite with a round pale yellow spot on each side, third to fifth with smaller spots. The female has the whole face reddish, except the middle of front; mesonotum entirely reddish, except a dark median line; legs brownish yellow. A variety from Mackay has the clypeus largely black in the middle and the orbital lines very widely broken.

Among all the Australian bees submitted to me at different times, I have never found this species. Mr. T. Rayment (1930) has recently described a species *Neoceratina rubinii* from Queensland, and this is evidently a *Nomada*. It was taken by Charles Barrett at Townsville. There is a good figure in Proc. Roy. Soc. Victoria, xliii., p. 56. It seems probable that it is identical with the species described by Perkins.

MELECTIDAE.

This family is represented in Australia by one genus:—

CROCISA Jurine.

Consisting of stout-bodied bees of medium to rather large size, having the scutellum extended posteriorly, in the form of a flattened place, which is deeply incised or emarginate, the margin often having the form of the letter W. These insects are among the most beautiful of bees, the pubescence taking the form of blue or white spots or bands, when blue often shining as if metallic. They are parasitic in nests of *Anthophora*, and are widespread in the warmer parts of the Old World. One species, as I am informed by Dr. J. Bequaert, has been taken as far north as Belgium. Although there are many *Anthophora* in America, *Crocisa* is wholly wanting.

There are two blue-spotted species of *Crocisa*, *C. novae-hollandiae* Lèpeletier and *C. nitidula* Fabricius, which have been reported from Australia, but appear not to exist there. I know them from Amboina. Dr. P. Meyer has revised the genus *Crocisa* in Archiv. f. Naturgeschichte, 1921.

(A.) White-spotted species.

- Length, 11-12 mm.; second tergite with an interrupted white band; margin of scutellum W-like *rotundata* Friese.
 Second tergite with four white spots 1.
 1. Middle and hind tibiae white only at base; size large . . *lugubris* Smith.
 Anterior and middle tibiae covered with white hair on outer and posterior side, except at apex; hind tibiae with the apical half free from white hair, except posteriorly; a much smaller species than *C. lugubris*, the male only 9 mm. long. *waroonensis* Cockerell.
 Middle and hind tibiae covered with white hair on outer side 2.
 2. Larger; margin of scutellum W-like *macleani* Cockerell.
 Smaller; margin of scutellum bracket-like, the edge on each side of the middle curved *quadrinaculata* Rads.

Crocisa lugubris Smith.

Described from "Australia," the type in British Museum. *C. albopicta* Cockerell, from Mackay, Queensland, was described as a distinct species, but on comparing my type, in the British Museum, with Smith's type of *C. lugubris*, I concluded that it could only rank as a variety or race of the latter. The spots are of the same colour in both. *C. albopicta* has a spot of white hair at median base of first abdominal tergite, and the anterior median mark on mesothorax is bar-like. In *C. lugubris* there is no white spot at median base of first tergite, and the anterior median mark on mesothorax is pyriform in outline.

Crocisa macleayi Cockerell.

Female a little over 14 mm. long. New South Wales. Type in American Museum of Natural History, New York.

Crocisa quadrimaculata Radoszkowski.

Finke River, South Australia; also Adelaide.

Crocisa rotundata Friese.

This is *C. albomaculata* Smith (the name preoccupied) and *C. albovittata* Friese. It is reported from Champion Bay and King George's Sound, W.A., and Mackay, Queensland.

Crocisa waroonensis Cockerell.

Discovered by G. F. Berthoud at Waroona, W.A. It is also known from Perth, and from Hermannsburg, Central Australia.

(B.) Blue-spotted species.

- | | |
|--|------------------------------|
| At least some of the tergites four-spotted | 1. |
| None of the tergites four-spotted, the lateral marks being undivided | 2. |
| 1. Margin of scutellum bracket-like | <i>lamprosoma</i> Boisduval. |
| Margin of scutellum W-like | <i>turneri</i> Friese. |
| 2. First tergite with the blue extending right across | |
| <i>novae-hollandiae</i> Lep. and <i>nitidula</i> Fab., not considered Australian. | |
| Abdominal bands all interrupted in the middle | 3. |
| 3. Blue markings shiny; margin of scutellum bracket-like | 4. |
| Blue markings not shiny; margin of scutellum W-like | 5. |
| 4. Hair on middle of occiput black with white on each side; apex of male abdomen more narrowly truncate | <i>omissa</i> Cockerell. |
| Occiput with a complete conspicuous fringe of white hair; apex of male abdomen more broadly truncate; size smaller, not over 9 mm. | <i>darwini</i> Cockerell. |
| 5. Large, length about 15 mm.; markings of abdomen pale blue. | <i>tincta</i> Cockerell. |
| Smaller, about 11 m.; markings of abdomen bright turquoise-blue, but not shining | <i>beatissima</i> Cockerell. |

Crocisa beatissima Cockerell.

Described from a female, in the British Museum, collected at Adelaide.

Crocisa darwini Cockerell.

Port Darwin, the type in British Museum.

Crocisa lamprosoma Boisduval.

This beautiful species appears to be rather common in Queensland, and goes south to the Blue Mountains, N.S.W. *C. australensis* Radzowski, said to go south to Tasmania, appears to be identical, and *C. caeruleopunctata* Blanchard is probably another synonym.

Crocisa omissa Cockerell.

Common in Queensland, and also found in New South Wales. It has been erroneously recorded as *C. quartinae* Gribodo and *C. caeruleifrons* W. F. Kirby, species which do not occur in Australia.* *C. omissa* occurs on Dunk Island.

Crocisa tinctoria Cockerell.

Toowoomba, Queensland; type in British Museum.

Crocisa turneri Friese.

Mackay and Cairns, Queensland; Meyer also cites it from Sydney, N.S.W.

ANDRENIDAE, subfamily NOMIINAE.

NOMIA Latreille.

The characters of this genus have recently been discussed at length in American Museum Novitates, 433 (October, 1930.) No less than fourteen segregates or subgenera have been proposed for the *Nomia* of different parts of the world, and it is a fact that the genus as now understood contains very diverse elements. For example, in some species the tongue is short or dagger-shaped, but it is long and slender in others, remarkably so in the Australian *N. gilberti* Ckll. Among the Halictine bees there is also a group with linear tongues, paralleling the condition of the long-tongued *Nomia*, but, of course, arising quite independently. In some species of *Nomia* the tegulae are very large, in others they are quite ordinary. There is a group with spined postscutellum. Using these and other characters, it would be possible to split *Nomia* up into a number of genera, and, as long ago as 1899, Ashmead recognised four genera. In a paper shortly to be published, I have treated the African *Meganomia* as a separate genus. No one, however, has yet treated the *Nomia* of the world in a single monograph, with adequate structural studies. *Nomia* may be confused with *Halictus*, and has been by describers of bees; but it is really very different. In the anterior wings, the small second cubital cell, with a large or long cell on each side of it, and the obtuse end of the marginal cell, are very distinctive. The males often have highly modified hind legs. The structure of the base of the metathorax differs from that of *Halictus*. The straight basal nervure (as in *Andrena*), contrasted with the arched or curved nervure of *Halictus*, is not reliable. Various Australian species of *Nomia*, especially for instance *N. brisbanensis* Ckll., have the basal nervure very strongly arched. Indeed, the arched nervure is normal for Australia *Nomia*.

The remarkable group *Reepenia* Friese, with a stigma on the hind wings, was proposed by Friese as a subgenus, based on a species (*N. variabilis* Friese) found in New Guinea. An Australian species has been discovered at Cape York, and I am treating *Reepenia* as a genus. It was, however, an error to refer *Tetralonia brevicornis* Smith to it. The follow-

* See Records Australian Museum, 1929, p. 231, where they are recorded from New Guinea.

ing key to Australian *Nomia* includes the species available when it was made, but all the species appear in the list beyond.

(A.) Metallic species, with blue or green colours.

- (a.) *N. Australica* group; large forms, the male sometimes hardly metallic.
 Clypeus of female broadly red apically *australica* Smith.
 Clypeus of female wholly dark *australica reginae* Ckll.
 Male with scape and flagellum both dark; hair of face, occiput and cheeks white; wings hardly at all dusky; abdomen dark purple-blue, not greenish; hair-bands white, only slightly tinged with yellowish *australica regis* Ckll.

The female *N. subaustralica* Ckll., about 11 mm. long, is black, the abdomen somewhat metallic; scape red in front; first recurrent nervure meeting second intercubitus; postscutellum covered with fulvous hair.

(b.) *N. flavoviridis* group, smaller species.

- Larger and more robust; mesothorax and scutellum entirely black; abdomen dark blue, not at all green, but may be red at end;
 female *gracilipes* Smith.
 Smaller and less robust; mesothorax metallic; abdomen green or bluish 1.
 1. Females 2.
 Males 3.
 2. Dark olive green, with fulvous tegulae; hind tibiae and basitarsi (except apically) clear ferruginous; punctures of disc of mesothorax distinct and separate under a lens (very different from *N. flavoviridis phanecura*); scutellum with a pair of black shining impunctate elevations (not present in *phanecura*) . . *hippophila* Ckll.
 Tegulae rufofulvous; hind tibiae and tarsi dark, with white hair; punctures of disc of mesothorax finer or denser; scutellum with no shining elevations *flavoviridis* Ckll.
 Head, thorax and abdomen entirely dark blue; apex of abdomen fringed with pale chocolate hair; anterior half of clypeus black; legs very dark rufous; mesothorax with minute punctures, and scattered larger ones, in the manner of *N. australica* *flavoviridis doddi* Ckll.
 Antennae dark, flagellum ferruginous beneath; nervures and stigma clear ferruginous; abdomen very green *flavoviridis adalaidella* Ckll.
 Smaller than typical *flavoviridis*, the length about 7 mm.; head and thorax dark bluish green, area of metathorax yellowish green; mesothorax dull and granular, the scattered punctures hard to observe (they are quite distinct in *flavoviridis* proper); tegulae large, bright apricot colour (in true *flavoviridis* dark brown, with hyaline borders); stigma and nervures red-brown; fifth tergite and apex of abdomen ferruginous . . *flavoviridis phanecura* Ckll.
 Head, thorax and first tergite blue; rest of abdomen almost black; legs brownish black; tegulae very dark rufous *babindensis* Ckll.
 3. Flagellum bright ferruginous, above and beneath; nervures and stigma clear ferruginous; abdomen greener than head and thorax. *flavoviridis adalaidella* Ckll.
 Flagellum black above (or dark brown in *N. hippophila*). 4.
 4. Tibiae entirely ferruginous, not at all metallic; tegulae clear apricot colour; a dark green insect (not at all blue) *flavoviridis phanecura* Ckll.

- Tibiae red with metallic reflections; tegulae rufofulvous; dark blue bee, with third and following tergites olive green *flavoviridis doddi* Ckll.
- Legs typically coloured as in *doddi*, varying to dark tibiae; mesothorax yellowish green *flavoviridis* Ckll.
- Legs dark; tegulae dull rufous (not apricot colour); head and thorax dark green; abdomen blue-green; much smaller than *doddi* *flavoviridis cyanella* Ckll.
- Rather larger, green, with bright red tegulae; legs mainly red, the tibiae entirely red *flavoviridis excellens* Ckll.
- About 7.5 mm. long; dark greenish, less robust and less metallic than *flavoviridis*; tegulae rather large, shining rufous; legs red-brown, the femora and tibiae more or less greenish metallic; stigma paler *hippophila* Ckll.
- Head and thorax olive green, with coppery tints; tegulae fulvous (or with a basal black shade), with pallid margins; hind femora metallic green, red at apex; hind tibiae mainly green *hippophila purnongensis* Ckll.
- Head, mesothorax and scutellum black, pleura dark green; lower half of clypeus white; tegulae clear bright apricot colour; stigma and nervures fuscous; abdomen olive green; third and fourth sternites each with a pair of light ferruginous protuberances *testaceipes* Friese.

(B.) Non-metallic species.

- Postscutellum with a forked process 1.
- Postscutellum without such a process 2.
1. Abdominal bands light green *darwinorum* Ckll.
- Abdominal bands suffused with vermillion *lyonsiae* Ckll.
2. Abdomen with bright orange tegumentary bands; large species *aurantifer swainsoniae* Ckll.
- Abdomen without such bands 3.
3. Apical part of abdomen (not merely borders of tergites) broadly red *ferricauda* Ckll.
- (Robust shining female from Como, N.S.W. . . *ferricauda musgravei* Ckll.)
- Apical part of abdomen not thus red 4.
4. Anterior wings with a conspicuous dark apical spot 5.
- (Apex dusky; abdomen long, claviform . . *pseudoceratina* Ckll.)
- Anterior wings not thus spotted 6.
5. Flagellum about 3.3 mm. long; more robust; hair on face pure white *kurandina* Ckll. (*macularis* Fr.)
- Flagellum a little over 2 mm.; less robust; hair on face dull and slightly yellowish *melvilliana* Ckll.
- (Large form from N.S.W. . . *kurandina fortior* Ckll.)
6. Legs pale testaceous; mesothorax and scutellum dark red; scutellum with two pointed eminences *Reepenia eboracina* Ckll.
- Otherwise 7.
7. Hind tibiae and tarsi clear bright red; tegulae bright red 8.
- Hind tibiae and tarsi not thus red 11.
8. Hind margins of tergites black *frenchi* Ckll.
- (*N. frenchi* has thin white hair-bands. The following separates it from species with dusky red hind tibiae and tarsi:—
- Flagellum all black *frenchi* Ckll., male.
- Flagellum red beneath.

- Flagellum longer, dark above
 *brisbanensis* Ckll., male (very near *frenchi*.)
 Flagellum shorter, all red *nana* Sm., male.
 Female with broad ochreous hair-bands on abdomen
 *satelles* Ckll. (near to *nana*.)
 Hind margins of tergites fulvous or yellowish red 9.
 9. Sides of mesothorax broadly covered with fulvous tomentum
 *tomentifera* Friese, both sexes.
 Sides of mesothorax not so covered 10.
 10. Female *semiaurea* Ckll.
 Male *rufocognita* Ckll.
 (Probably sexes of one species; see Entomologist, 1913, p. 121.)
 11. Abdomen with broad bands of tomentum, in style of *N.*
austratica 12.
 Not like *N. australica* in abdomen 15.
 12. (All have clear red tegulae.)
 Middle of mesothorax, except posteriorly, with tegument red.
 *dimissa* Ckll., female.
 Mesothorax without red 13.
 13. Female; hair-bands ochreous *satelles* Ckll.
 Males 14.
 14. Mesothorax more hairy *satelles* Ckll.
 Mesothorax less hairy *nana* Smith.
 (These two are probably forms of one species.)
 15. Abdomen claviform, with narrow base, and narrow ochreous hair-
 bands 16.
 (With white hair-bands; knees red; tarsi very pale reddish. *Williamsi* Ckll.)
 Abdomen otherwise 17.
 16. Nearly 10 mm. long, first tergite very long . . . *pseudoceratina* Ckll., male.
 Not so long; stigma much paler *halictella* Ckll., male.
 17. Hind tibiae dusky red (red with a black spot in *ulongensis*)
 18.
 Hind tibiae black, at most red at end (red in *ulongensis*) 19.
 18. Flagellum black (also in *ulongensis*) *frenchi* Ckll., male.
 Flagellum red beneath *brisbanensis* Ckll., male.
 (Antennae much shorter than in *frenchi*; legs dark brown. *geophila* Ckll.)
 19. Hind basitarsi red (whitish in male *williamsi*) 20.
 Hind basitarsi black or very dark brown 24.
 20. Larger; abdomen very black, margins of tergites not testaceous
 *moerens ulongensis* Ckll., male.
 Smaller; abdomen with margins of tergites beyond first testaceous
 21.
 21. Male (Thursday I.) *semiaurea thor* Ckll.
 Females 22.
 22. First tergite subtriangular in outline, seen from above.
 *halictella* Ckll., female.
 First tergite short and very broad 23.
 23. Smaller; abdomen more distinctly punctured . . . *semipallida* Ckll.
 Larger; abdomen less distinctly punctured; hind tarsi obscure
 reddish *tenuihirta* Ckll.
 24. A light band of hair in suture behind mesothorax (traces of band in
 larger *semiaurea*) 25.
 No such light band of hair 28.

25. The light band, and tomentum covering postscutellum, fulvous 26.
 The light band, and hair on postscutellum, white 27.
26. Area of metathorax broadened in middle *triangularis* Ckll.
 Area of metathorax narrow in middle *halictella* Ckll.
27. Larger; area of metathorax sharply bounded *moerens* Smith.
 Smaller; area not sharply bounded; postscutellum covered with dense
 pure white tomentum *grisella* Ckll.
28. Hind margins of tergites beyond first broadly pale orange (Thursday
 Island) *semiaurea thor* Ckll.
 Tergites not thus 29.
29. Extreme apex of abdomen clear red 30.
 Apex not thus red 31.
30. Broad hair-bands on abdominal tergites 3 and 4
 *victoriae* Ckll. (*fulvoanalis* Fr.)
 Lacking broad hair-bands on tergites 3 and 4; tergites 1 to 4 with
 only short lateral stripes of pure white hair *analis* Friese.
31. Females 32.
 Males 35.
32. Mesothorax covered with short grey hair, behind which is the intense
 black scutellum, and then dense pure white hair covering post-
 scutellum *muscosa* Ckll., female.
 Not thus ornamented 33.
33. Tegulae black; wings very dark 34.
 Tegulae dark rufous; scutellum dull *brisbanensis* Ckll.
 Tegulae pale testaceous, with or without a dark spot . *tenuihirta* Ckll.
34. *submoerens* Ckll. and *moerens* Sm.
 (Submoerens has transverse cross-striated channel of metathorax
 much narrower in middle, its lower margin straight, except at
 sides; wings shorter, nervures darker; tegulae anteriorly with a
 pale marginal spot.)
35. Mesothorax covered with short moss-like grey hair . . *muscosa* Ckll.
 Mesothorax not so covered 36.
36. Tegulae very dark brown. *hypodonta* Ckll. var. a. (Turner, 1897.)
 Tegulae broadly pale margined *gilberti* Ckll.
 (Like *gilberti*, but antennae a little shorter, mesothorax shining,
 postscutellum, without the dense covering of pure white hair.
geophila Ckll.)

Nomia aenea Smith.

Based on a male from Port Essington. It is obscurely aeneous; femora rufo-piceous, tibiae and tarsi ferruginous; flagellum fulvous beneath; apical margin of clypeus and mandibles ferruginous; wings hyaline; apical margins of second and following tergites with pale fulvous pubescence. The hind leg is figured in Trans. Ent. Soc. London, 1875, pl. 2, fig. 13. This is a small species, of the *N. flavoviridis* group, not found in recent years.

Nomia aerata Smith.

Described from a male, with no better locality than Australia. It is even smaller than *N. aenea*, of a brassy colour, the head and thorax obscurely so. The flagellum, anterior margin of clypeus and mandibles (except extreme base) rufo-fulvous; legs ferruginous, the femora rufo-piceous above; hind femora slightly swollen, and tibiae dilated at apex; abdomen bright and brassy.

Nomia alboscopacea Friese.

Recorded from Queensland; Mackay, Cairns, Atherton and Colosseum. Female 9 mm. long, male 8 mm. It is said to be nearest to *N. dentiventris* Smith, but more robust, with simple hind legs and venter in male. The female is black, the mesothorax densely yellowish-grey haired; tegulae pale, with browner disc. The abdomen has distinct hair-bands only on tergites 3 and 4. I think this is identical with *N. tenuihirta* Ckll.

Nomia analis Friese.

Found by Turner at Mackay, at flowers of *Cassia*. I had it as a variety of *N. victoriae*, but it appears to be a distinct species, lacking the broad hair-bands on tergites 3 and 4, tergites 1 to 4 having only short lateral stripes of pure-white hair. In nearly all respects it agrees with *N. victoriae*.

Nomia argentifrons Smith.

A small species, size of *N. aenea* (length 4 lines), in the collection of Sir John Lubbock. The sex is not given, but it is evidently a male, having the hind femora incrassate, the tibiae incrassate and broadly expanded at apex. Black, with scape in front, apex of clypeus, mandibles and anterior tibiae in front pale rufotestaceous; flagellum fulvous beneath; wings hyaline, faintly clouded at apical margin; tergites with white hair-bands, the first broadly interrupted.

Nomia aurantifer Cockerell.

Cairns and Kuranda, Queensland; type in British Museum. *N. luteofasciata* Friese, is the same. *N. aurantifer swainsoniae* Cockerell, is a race described from the National Park, Queensland, but also found by Gibbons at Sydney.

N. aurantifer is a magnificent species, the female about 12 mm. long, with the hind margins of tergites 2 to 4 broadly smooth and shining, and of the most brilliant orange; the wings are strongly infuscated. The race *swainsoniae* (found at flowers of *Swainsonia*) has also an orange band, broadly interrupted in middle, on first tergite; wings dusky subhyaline, with the apical margin broadly darkened. The male *swainsoniae* has five orange bands, the first very slender, and obsolescent in middle; the hind tibiae are swollen, with a large apical finger-like projection, but no spurs.

Nomia australica Smith.

This is the common, relatively large, metallic species, found from West Australia to Victoria, and north to Queensland. Two races have been described; *reginae* Ckll., from Mackay and Townsville, Queensland, and *regis* Ckll., from north-west Australia. The race *reginae*, omitted from Hacker's Catalogue, is described in both sexes in Entomologist, September, 1905, p. 221. Adelaide is to be considered the type locality of *N. australica*. Specimens from Melbourne show a black clypeus and scape in the female, and scape varying from black to red in the male. The race *reginae* has the hair-band on second tergite entire. At Sandringham, Victoria, Mr. Rayment finds *N. australica* visiting *Coreopsis* and *Hypochaeris*.

Nomia babindensis Cockerell.

Female about 6 mm. long, taken by F. X. Williams at Babinda, Queensland, in 1919. It is known among the metallic species by the small size

and blue colour, with dark tegulae and mainly black abdomen. The antennae are dark.

Nomia brisbanensis Cockerell.

Brisbane, Stradbroke Island and Bribie Island, Queensland. Related to *N. moerens* Smith, but less robust and with much lighter tegulae. I thought at first it might be a colour-variety of *N. frenchi* Ckll., but the fourth sternite in middle is smooth and shining, with a strong sulcus, which ends a little before the emarginate apex; whereas the fourth ventral in *frenchi* is roughened and slightly ridged in middle, with a rudimentary sulcus at extreme base.

Nomia darwinorum Cockerell.

Male collected by Turner at Port Darwin; type in British Museum. Length about 10.5 mm.; very close to *N. pulchribalteata* Cameron from New Britain, but somewhat larger; hair of face very dense, greyish white; wings clearer; hind femora more swollen; hind tibiae and tarsi without red; abdominal bands considerably broader, apple-green, shot with vermillion; fourth sternite with a very distinct fringe of white hair. The scutellum is bituberculate, and the postscutellum has a pair of long tooth-like structures.

Williams collected both sexes at Halifax and Babinda, Queensland. The female proves to agree very nearly with *N. rubroviridis* Ckll., except that the flagellum is variably reddened beneath, and the hair of the apical tergites is very dark fuscous, not ochreous. It thus appears probable that *N. darwinorum* is no more than a race of *N. rubroviridis*.

Nomia dentiventris Smith.

Based on a small male from Sydney, of the same size as *N. aenea*. Black, the abdomen with pale fulvous hair-bands, the third sternite with two blunt teeth; hind femora dilated, the tibiae dilated and abruptly narrowed at their base; tegulae dark rufo-testaceous; legs rufo-piceous, with tibiae, tarsi and apex of femora ferruginous.

Nomia dimissa Cockerell.

Found by F. P. Dodd in the Cairns district, Queensland. The male is like *N. australica reginae*, but is smaller and more slender (length about 10.5 mm.), with hyaline wings, faintly dusky at apex; hair of face white, hardly perceptibly yellowish; abdomen dark blue; hind tibiae, seen from behind, with the inner margin strongly angulate below the middle; anterior lobe of hind tibiae much more broadly truncate. Known from *N. australica regis* by the flagellum ferruginous beneath, and the abdominal hair-bands strongly yellow. The female has a large red patch on mesothorax in front.

Nomia ferricauda Cockerell.

Discovered by Hacker at Brisbane in 1911. It is black, about 8 mm. long (female), and readily known by the black and red abdomen. The legs are dark. Mesothorax dull, with scattered large punctures and numerous extremely minute ones. At Como, N.S.W., Musgrave and Campbell found a distinct race, *N. ferricauda musgravei* Ckll., the female with the third tergite all black, with the broad band of appressed hair greyish-white; fourth tergite black at base, and more broadly at sides, the abdomen beyond this red; area of metathorax not so large, and not so distinctly and regularly cross-ribbed.

Nomia flavoviridis Cockerell.

The type, from Mackay, is in the British Museum. There are several races or subspecies, the characters of which are given in the table. *N. f. doddi* Ckll. was based on males from Townsville (F. P. Dodd), and a female from Parry Harbour, Cape Bougainville.

N. f. Adelaidella Ckll. is from Adelaide (Schomburgk), the type in the Berlin Museum.

N. f. cyanella Ckll. was taken by Turner at Cooktown, Queensland. *N. f. phanerura* Ckll. was from Mackay (Turner), but has since been taken as far south as Brisbane.

N. f. excellens Ckll., collected by C. Gibbons at Sydney, is in the Australian Museum. (See Records Australian Museum, xvii., 1929, p. 226.) The *N. flavoviridis* group, whether regarded as consisting of species or races, will only be adequately elucidated by careful field work and dissections.

Nomia frenchi Cockerell.

Male from Woodend, Victoria (French). Black, length about 7.5 mm.; separated from *N. generosa* Smith, by the enlarged hind femora and tibiae, and the dark hair on the thorax above; and from *N. argentifrons* Smith by the black flagellum, and red tibiae and tarsi. It is also allied to *N. moerens ulongensis* Ckll., which is 10.5 mm. long.

Nomia generosa Smith.

The type is a male from Moreton Bay, Queensland. It is black, closely and finely punctured, the tibiae and tarsi bright ferruginous; antennae as long as head and thorax; tergites after the first with narrow white hair-bands. The hind femora and tibiae are not enlarged. It is recorded from Mackay in Amer. Mus. Novitates, 343, 1929, p. 11.

Nomia geophila Cockerell.

Male 8 to 9 mm.; black, with hind margins of second and following tergites hyaline. It is closely related to *N. gilberti* Ckll., but has antennae a little shorter, mesothorax shining, and postscutellum without the dense covering of pure white hair, nor are there conspicuous white hair-patches at sides of scutellum. In *N. frenchi* the antennae are very much longer. Type in Queensland Museum (Mem. Queensland Museum, x., 1930, p. 49.)

Nomia gilberti Cockerell.

Mackay (Turner). The female is very like *N. tenuihirta* Ckll., from the same locality, but is known by the honey-coloured stigma; more hyaline wings, with the apex obviously darkened; piceous tegulae, with a whitish spot on outer margin; and the structure of the metathorax.

Nomia gracilipes Smith.

Smith described both sexes from Adelaide. Head and thorax black, the abdomen blue, with the apex ferruginous. The flagellum is bright fulvous beneath in the male. This is a conspicuously smaller species than *N. australica* Smith. In a female from Darra, Brisbane, the last three tergites were chestnut red, much brighter than usual.

Nomia grisella Cockerell.

Female about 9 mm. long, from Cape York, Queensland. It has more recently been taken at Gordonvale. It is very close to *N. muscosa* Ckll.,

but third joint of labial palpi longer; mesothorax not so hairy, the dull, very finely punctured surface visible; hind margins of second and following tergites light testaceous. The tongue is long and filiform.

Nomia halictella Cockerell.

Found by Turner at Mackay, and now known as far south as Brisbane. Type in British Museum. The female is about 8.5 mm. long, with the aspect of an *Halictus*; the tergites have the hind margins rufescent, those of third and fourth with broad, dense, entire fulvo-ochraceous hair-bands; on the first and second tergites these bands only appear laterally, or the band on second may be nearly complete. The wings are strongly dusky. The form described as variety *triangularis* is a distinct species. The male *N. halictella* has a subclavate abdomen.

Nomia hippophila Cockerell.

The type, in Berlin Museum, was collected by Coulon at Port Phillip, Victoria. The species goes north to New South Wales. The characters of this, and its race *purnongensis* Ckll., from Purnong, S.A., are sufficiently indicated in the key.

Nomia hypodonta Cockerell.

Mackay, Queensland; type in British Museum. Allied to *N. dentiventris* Smith, but the male (about 8 mm. long) has the pubescence of a different colour (of head and thorax white, a little yellowish on face, vertex, mesothorax and scutellum), the hind femora do not present a large swelling beneath, and the ferruginous colour on the legs is lacking. The abdomen is blue-black, with the hind margins of the tergites pure black; the third sternite has a pair of prominences, each terminating in a short sharp spine. A variety has the flagellum dull reddish beneath.

Nomia kurandina Cockerell.

Kuranda, Queensland (Turner). Related to *N. gilberti*, but easily separated by the apical spots on anterior wings. The male is about 9 mm. long. The female has the dark wing spots more dilute; the clypeus and supraclypeal area show a strong median ridge. The type is in British Museum. *N. macularis* Friese, described from Mackay, appears to be the same species.

N. kurandina fortior Ckll. (Rec. Australian Museum, xvii., p. 226) is a larger race from Gundamaian, Port Hacking, N.S.W., where it was found by T. G. Campbell. It has the dark apical wing-spots large and very conspicuous. Antennae and tegulae entirely black.

Nomia latetibialis Friese.

Male from Adelaide. A very distinct species, rather suggestive of *N. gracilipes* Smith. Head and thorax black, but abdomen dark red suffused with purple, the third and fourth tergites dark dull purple, except the red hind margins, while the last two tergites are pale testaceous. There are no hair-bands. The venter is flat and simple, except that the fourth sternite is emarginate in the middle, and from beneath the emargination projects a stout curved red spine. Flagellum very long.

Nomia latiuscula Friese.

Female collected by Turner at Mackay. Length 8 to 9 mm., said to be nearest to *N. cincta* Sm., but clypeus short, normal; pubescence fulvous;

wings with darkened margin; legs rufous or fulvous. So far as I can make out, this is a synonym of *N. semiaurea* Ckll.

Nomia lepidota Cockerell.

Female from Sydney; type in British Museum. It is about 7 mm. long, black, with the hind margins of tergites narrowly reddish. It is known by the very large tegulae (about three-quarters length of mesothorax), and bandless abdomen. The flagellum is obscure ferruginous beneath; legs very dark reddish.

Nomia lyonsiae Cockerell.

Female collected by Hacker at Brisbane and Stradbroke Island, Queensland. This is a species allied to the Indian *N. ellioti* Smith, having a bidentate structure on postscutellum, which is like a fish tail in the female, but has sharper points in the male. The male has a pair of small projections on the strongly bilobed scutellum. The abdomen has broad green tegumentary bands, suffused with vermillion. When the female was described, it was suggested that it might belong with *N. darwinorum* Ckll., then only known from the male. Now having both sexes of each, I fail to find any very salient differences, though the scutellum (female) of *N. lyonsiae* is larger and more flattened. I can only conclude that *N. lyonsiae* is at best a weak race of *N. darwinorum*, which is itself hardly more than a race of *N. rubroviridis*.

Nomia melanodonta Cockerell.

Male, about 9 mm. long, from Wodonga, Victoria; type in Melbourne Museum. It looks like *N. frenchi*, but has the flagellum bright ferruginous beneath, dark red above; hind tibiae subtrigonal, with a prominent apical anterior broadly truncate lobe; fourth sternite deeply emarginate, and from the emargination proceeds a polished sharp black tooth. There is no such tooth in *N. frenchi*.

Nomia melanoptera Cockerell.

Found by Turner at Kuranda, Queensland; type in British Museum. The female is nearly 10 mm. long, similar to *N. stalkerii*, *N. gilberti*, etc., but distinguished by the very dark wings, dark spurs, and feebly sculptured abdomen. It is rather robust, with white and black hair; eyes strongly converging below; a more or less evident raised line down middle of clypeus; tongue long and linear.

Nomia melvilliana Cockerell.

Male, a little over 7 mm. long, from Melville Island (G. F. Hill); type in American Museum of Natural History. It is very close to *N. kurandina*, but less robust, with shorter flagellum. The tegulae are pale testaceous. (Amer. Mus. Novitates, 346, 1929, p. 4.)

Nomia moerens Smith.

Appears to be a common species, from Victoria to National Park, Queensland. The characters are indicated in the table. *N. moerens ulongensis* Ckll. (Rec. Austral Mus., xvii., p. 227), from Ulong, East Dorrig, N.S.W., is based on males, 10.5 mm. long, with deep chestnut red tegulae. The mandibles, clypeus and antennae are entirely black; hind femora swollen, shining, not appreciably curved; hind tibiae stout, trigonal, the

anterior edge bulging, but no apical lobe. Smith suggested that *N. generosa* was probably the male of *N. moerens*.

Nomia muscosa Cockerell.

The type, from Mackay, is in the British Museum; the species goes south to New South Wales. The female, about 10 mm. long, is superficially like *N. melanoptera*, but has the mesothorax covered with a greyish moss-like tomentum, which appears black-speckled from the origin of many bristle-like black hairs; area of metathorax quite different, the apical triangle dull, and not cut off from the very narrow finely cross-ridged basal band; wings not nearly so dark. The male is similar, with the hind legs very little modified.

Nomia nana Smith.

New South Wales and South Australia. A specimen in the British Museum is labelled North-west Australia, but this habitat seems to need confirmation. Smith described the male as *N. ruficornis*, and this name being preoccupied, *N. smithella* was substituted by Gribodo in 1894. The characters of *N. nana* are indicated in the table.

Nomia pennata Friese.

Male, 6-6.5 mm. long, from Adelaide. It is said to be like *N. turneri* Friese, but with long antennae, fulvous tarsi, and a small brown spot at end of anterior wings. Legs black; tibiae and tarsi more or less fulvous, hind tibiae with a dark spot; tegulae brown; wings hyaline.

Nomia pseudoceratina Cockerell.

The type, from Mackay, is in the British Museum. From recent studies (Psyche, June, 1930, p. 146) I have concluded that this is the male of *N. halictella* var. *triangularis*. It is a distinct species, to be called *N. triangularis* Ckll.

Nomia pulchribalteata austrovagans Cockerell.

The type, from F. Smith's collection, is in the British Museum, and is labelled as coming from Adelaide. The male, with two long black spines on postscutellum, is very close to *N. westwoodii* Gribodo, from Bengal, and *N. pulchribalteata* Cameron, from New Britain, but is known by the purple tints of the abdominal bands, resembling in this respect *N. formosa* Sm., from Celebes. A full description appears in Entomologist, September, 1905, p. 218. I cannot help suspecting that the locality is erroneous.

Nomia rubroviridis Cockerell.

North-west coast of Australia. Female about 10.5 mm. long; post-scutellum with a bifid fish-tail like process; tegulae large, the inner hind corner pointed, the base fuscous, the middle ferruginous, the outer hind part broadly creamy-white; antennae dark; hind margins of first four tergites with very broad entire emerald-green bands, the first two suffused on their anterior half with vermillion; fifth tergite with a dense fringe of ochreous hair, and apical segment covered with the same. Type in British Museum. Although marked North-west Australia, it bears also the accession number 69.50, which is said to mean "purchased from Mr. Du Boulay, collected in W. Australia, Nicol Bay, Swan River and Champion Bay."

Nomia rufocognita Cockerell.

Type, in British Museum, from Mackay. It is a male, and was said to

be closely allied to *N. generosa* Sm., but distinguished by the fulvous pubescence. The tegulae are ordinary, bright ferruginous, the margins subhyaline; tibiae and tarsi bright ferruginous, the tibiae with a blackish spot in front. Length about 9 mm. In Entomologist, April, 1913. I considered that this must be the male of *N. semiaurea* Ckll., from the same locality. However, in Ann. Mag. Nat. Hist., July, 1829, p. 137, I described what I regarded as the true male of *N. semiaurea* from Thursday Island. It has a remarkable long black flagellum, the joints curved and producing a twisted effect. All the tarsi are bright chestnut red, the anterior and hind tibiae red at apex. This Thursday Island bee was later separated (1930) as *N. semiaurea thor* Ckll. It is perhaps a fact that *N. rufocognita* is after all *N. semiaurea*, and the Thursday Island insect a distinct species, *N. thor*?

Nomia satelles Cockerell.

The type was taken by French at Rutherglen, Victoria. It also occurs in New South Wales. It has a general resemblance to *N. australica* Smith, but is easily separated by the smaller size (male about 8.5 mm., female 9.5 to 10 mm.), and black colour. The first tergite of the female is closely and finely punctured on the disc as in *N. australica*.

Nomia semiaurea Cockerell.

Type female from Mackay, in British Museum. For the characters see the table, and the above discussion under *N. rufocognita*. It is to be noted that *N. semiaurea* and *N. rufocognita* were both published September, 1905; being thus of even date, I choose *N. semiaurea* as the name of the species, if they are united.

Nomia semipallida Cockerell.

Type female, about 8 mm. long, from Mackay, in British Museum. Known by the broadly whitish margins of the tergites. Antennae wholly dark; mandibles light ferruginous with the apex black; tongue long and slender; wings dull hyaline; tegulae pale rufous, with a dark basal spot. The second cubital cell is extremely small.

Nomia stalkerii Cockerell.

Type in British Museum, collected by W. Stalker at Alexandria. It is a male, about 10 mm. long; black, the head and thorax with abundant pale hair, white below, faintly yellowish dorsally; antennae short for a male, flagellum less than 3 mm., ferruginous beneath; wings strongly dusky; hind legs not modified. Very close to *N. tenuihirta* and *N. gilberti*, but known by the darker wings and red spurs.

Nomia subaustralica Cockerell.

Based on the female, in Berlin Museum, from Tennant's Creek, South Australia. Also from Finke River, Hermannsburg. It is about 11 mm. long, the abdomen somewhat metallic, with broad pale ochreous hair-bands. It resembles *N. australica*, but differs in many points, having scape red in front; base of flagellum (about two joints) lively red above and below, rest of flagellum black, except a reddish stain at apex; tegulae pale testaceous, the margins whitish; mesothorax densely covered in front, behind, and more or less at sides with easily deciduous moss-like light fulvous hair, and with no erect black hair; stigma shorter; abdomen black. The first two tergites strongly tinted with green (or purplish on second).

Nomia submoerens Cockerell.

Discovered by Littler at Bridport, Tasmania. It appears to be common on that island. The female is like *N. moerens*, but the transverse cross-striated channel at base of metathorax is much narrower in middle; wings shorter, nervures darker; tegulae anteriorly with a pale marginal spot.

Nomia tenuihirta Cockerell.

Collected by Turner at Mackay; type in British Museum. The male is about 8 mm. long; black, even to the tarsi, the flagellum obscure brownish beneath; abdomen without distinct hair-bands. The female is very like that of *N. gilberti*, but has the basal enclosure of metathorax almost linear at sides, dull, granular, without distinct cross-ridges; tegulae pale testaceous, fuscous basally, and with a whitish patch posteriorly; stigma dark reddish-piceous; wings more dusky, the apex uniform with the rest. *N. latitarsis* Friese is a synonym.

Nomia testaceipes (Friese).

Male found by the celebrated botanist von Mueller in Central Australia. It is one of the *N. flavoviridis* group, distinguished by the black head, mesothorax and scutellum (though dark green pleura); lower half of clypeus white; flagellum bright ferruginous beneath, but dusky above; tegulae clear bright apricot colour; legs red, with the femora more or less dark; abdomen dark olive green, but lighter and brighter on first tergite; third and fourth sternites each with a pair of light ferruginous protuberances.

Nomia tomentifera (Friese).

A Queensland species, from Kuranda, Babinda, Cooktown and Dunk Island. It is a distinct form, readily determined from the table. Friese sent out both this and *N. semiaurea* as *N. cincta* var. *tomentifera*; the differences are set forth in Amer. Mus. Novitates, 343, 1929, p. 10.

Nomia triangularis (Cockerell).

Type from Mackay, in British Museum. See above under *N. pseudoceratina* and *N. halictella*. The differential characters are given in the table.

Nomia turneri Friese.

Male, 7 mm. long, taken by Turner at Mackay, at flowers of *Eucalyptus* in March. It is said to resemble *N. nana* Sm. (but what Friese had as *N. nana* was *N. halictella* Ckll.), but with unusually short and thick antennae, and tergites 2 and 3 with reddish margin. All the tarsi are yellowish; wings almost clear; tegulae brown.

Nomia victoriae Cockerell.

Type, in the Berlin Museum, from Ararat, Victoria. *N. fulvoanalis* Friese, from the same locality, is a synonym. For the characters see the table, and note under the closely related *N. analis* Friese. See also Amer. Mus. Novitates, 343, 1929, p. 9.

Nomia williamsi Cockerell.

Male taken by F. X. Williams at Halifax, Queensland, in 1919; type in Museum of Comparative Zoology, Harvard University. It is about 7.3 mm. long, very close to *N. halictella*, but smaller, with white instead of fulvous hair, and darker flagellum. The stigma is large, light orange-fulvous, the

nervures pale testaceous; hind legs not modified; venter of abdomen simple, except for a large patch of pale fulvous-tinted tomentum. The scape is entirely black, whereas in *N. argentifrons* Sm. it is rufotestaceous in front.

I have not tried to sort the above *Nomia* into subgenera, but the subgenus *Hoplonomia*, Ashmead, 1904, includes those with a bidentate process or pair of spines on postscutellum, and metallic tegumentary bands on abdomen. It is found widely distributed in the Oriental Region. The Australian species are very closely allied to the Asiatic ones.

Friese, in 1924, published a "*Nomia* (?) *flavopunctata*," female 7 mm. long, found by Turner at Mackay, visiting *Xanthorrhoea* in April. It is said to be known by the anterior corners of thorax and the tubercles thickly covered with yellow tomentum. This seems to me to be a *Paracolletes* of the type of *P. irroratus* Smith, for the characters of which see Ann. Mag. Nat. Hist., June, 1926, p. 661.

REEPENIA Friese.

Published in 1909 as a subgenus of *Nomia*, the type being *N. variabilis* Friese. It was separated on the abdominal characters, but the stigma on the hind wings (at least in the Australian species) is more remarkable.

Reepenia eboracina (Cockerell).

The male was found by Froggatt at Cape York, Queensland. It also occurs at Gordonvale. I have placed the species in the table of *Nomia*, where sufficient characters for recognition are given.

The genus *Nomioides* is related to *Halictus*, not to *Nomia*.

NOTE.—In the account of *Megachile* (Q.) signifies that the species is represented in the Queensland Museum.

A FURTHER CONTRIBUTION TO THE BREEDING HABITS OF
MOGURNDA (MOGURNDA) ADSPERSUS CASTELNAU:
THE TROUT GUDGEON.

By R. HAMLYN-HARRIS, D.Sc.

(Communicated by G. A. Waterhouse, D.Sc.)

The breeding of small native larvivoracious freshwater fish, such as the Gudgeons, Sunfish, etc., in captivity, will develop quite naturally, along normal lines—(a) when the fish have become used to their surroundings and remain undisturbed, (b) the water in the aquarium has become well balanced, (c) if the fish are mature and in good condition, and (d) if the food supply is abundant and constant. Regular observations made from time to time on other oviparous larvae-eating fish, spread over a period of five years, suggest that their breeding habits are not markedly dissimilar.

Some notes on the habits of Queensland larvivoracious fish, together with illustrations are given by Hamlyn-Harris (3).

On October 24th, 1930, a pair of mature Trout Gudgeons (*Mogurnda* (*Mogurnda*) *adpersus* Castelnau) managed to produce a cluster of about 150 transparent eggs laid on one of the glass sides of an aquarium roughly measuring 14 x 24 x 14 inches; the male, a fine specimen of about 4½ inches in length, instantly took charge of the eggs, fertilised them, and then at fairly regular intervals throughout the day kept the water and the eggs in a constant state of agitation by the slow motion of the pectoral fins.

At least a week prior to the deposition of these eggs, the male had paid marked attentions to the female, which she on her part did not resent. Her restlessness was characteristic, she kept him constantly on the move, when they did come into contact she would roll over on her side in the most tantalising manner, whilst the male would literally shiver all over and do likewise; meanwhile the display of nuptial colouring was unceasing—or, when cornered, the female would lie prone on the bottom of the sand, whilst the male would poke or prod his mate with his mouth, she rolling over the while. This peculiar method of drawing attention to one another is common in both sexes, and is not confined to any one particular species.

The following table gives an excellent bird's-eye view of what was enacted during oviposition, covering a period of about four months.

Batch No.	Egg Laid.	Eggs Hatched.	Interval in days between one batch and another.
1.	Oct. 24th	Oct. 30th	2 days
2.	Nov. 2nd	Nov. 7th	3 days
3.	Nov. 10th	Disappeared over night	3 days
4.	Nov. 13th	Nov. 19th	4 days
5.	Nov. 24th	Dec. 1st	6 days
6.	Dec. 7th	Dec. 13th	—
7.	Jan. 29th	Feb. 5th	—

The first six batches of eggs were laid by the same female and cared for by the same male—the former died on December 16th, and was replaced by another mate on January 27th of the following year, and, two days after, the seventh batch of eggs was laid.

The interval between the hatching of the eggs and the laying of the new batch was spent by the male mainly in an ostentatious display of nuptial finery, and the female, in order to demonstrate her affability, likewise assumed colouring not unlike that of the male. There is not much difference between the male and the female, except perhaps in the size of the fins, though the male colouring is, if anything, more intense. Blewett (1) refers to individualistic differences of size and colour, none of which are of any diagnostic value. Whilst these attentions were in full swing the female remained afloat, but as soon as she commenced to resent him, she would sink to the bottom of the tank, in hiding, and change to a darker or less conspicuous colour.

As soon as the first batch of eggs had been laid, the male treated the female with great hostility, and unless successful in keeping her at a distance of at least a tank's length, he seemed restless, making menacing darts here and there in the water. This hostility to the female was extended to all other fish in the tank, and for a long time these smaller fish eluded him and sought shelter from his onslaughts by hiding amongst the green vegetation or debris at the bottom of the tank, always assuming a protective colouring so that they became dark and almost invisible in the debris, or grey and mottled in sand. This hostility to other fish persisted until they were finally disposed of.

The parents now in full possession of the tank became less agitated, and the male confined himself to the care of the eggs by bringing his body into close contact with them, and by constant working of the pectoral fins, would keep the eggs in a state of movement and agitation; sometimes the ventral fins were also brought into play at the same time as the caudal fin. Whilst this was going on the mouth kept opening and shutting, the whole movement seeming to be in the nature of a caress.

This was carried out at intervals of about half an hour or less throughout the whole six days. What happened at night did not transpire, but it is surmised that both sexes would be more or less quiescent during the hours of darkness. I have visited the aquaria on many occasions during the early part of the night and have found the fish invariably lying motionless on the sandy bottom.

The eggs hatched out on the 30th, having accomplished exactly six days of incubation, the young fish measured 4-5 mm. long. No sooner had the eggs hatched out than the male once more resumed friendly relationship, his attentions being responded to ungrudgingly.

The deposition and the fertilisation of the ova of this species is probably done in the early hours of the morning; it never actually fell to my lot to see the process. As a rule these intimate relationships were never observed when anyone was on the move. The impression gained was that these fish are naturally shy and quick to notice the presence of an intruder; aquarium fish take little notice of their owners, but distinctly resent the interference of a stranger. Though Gale (2) makes some reference to the fertilisation of the ova, it is quite clear from his description that he never actually saw the emission of the milt.

A second batch of eggs, rather less in number than the first, was found deposited on the same side of glass a few inches from the first, on Monday morning, November 3rd. The amount of attention given by the male to this second batch was considerably less than that bestowed upon the first, and yet the great majority hatched out on November 7th and the remaining 12 on November 8th, apparently none the worse. By this time the male had once again resumed nuptial colouring, with the constant snapping

of the jaws and a display of his really beautiful extended fins he had no difficulty in commanding the attention of the female. From observation it seems fairly conclusive that these preliminary tactics are absolutely necessary as a measure towards the development of the eggs, the fertilisation of which, however, does not take place until the eggs have left the female's body.

On November 10th a third batch of eggs was laid on another side of the tank and the male seemed to take no interest in these at all, possibly they remained unfertilised, for by November 11th the eggs, with the exception of three, had utterly disappeared. By November 13th a fourth and larger batch of eggs was laid over night, between 5 p.m. and 10 a.m. the next morning. The devotion of the male towards this fourth lot of eggs was exemplary, the female remaining motionless in the far corner of the tank, whilst the male's only movements during this period were devoted to the actual care of the eggs.

By November 17th the eggs were far advanced, the pigment spots showing up very clearly; they all hatched out by the morning of November 19th. "Courting" started again almost immediately, and by November 24th the fifth batch of eggs consisting of about 100 appeared. This was guarded and fanned just as the others had been, until the hatching of the eggs six days after.

Now, in order to give the young fish a chance, it was decided on December 2nd to move the parents to another tank, and the young were left to their own resources. The mortality among these was enormous, for out of the whole five batches of eggs only about a couple of dozen ultimately survived. Blewett (1) in his interesting observations on this fish refers to the inability of the young fry to swim properly. Nothing of this sort was noticed by me; the young seemed perfectly balanced at all times as they moved through the water.

Soon after this the parents were fed on a more lavish scale in order to test the extra activities which might result therefrom. Young tadpoles, being particularly plentiful at the time, were placed in the tank, and were devoured by both sexes in large quantities. A diet of mosquito larvae was not by any means refused by either sex at any time during the breeding season. Development was undoubtedly influenced, and another, the sixth batch of eggs was laid by December 8th, the eggs were more numerous than ever and numbered about 200 in all. By December 13th all eggs had hatched by 9 a.m. and, contrary to expectations, the male became extremely antagonistic to his mate, possibly because she found the young a dainty morsel. After this she became completely cowed and remained so until her death on December 16th. It is difficult to say to what cause death was actually due, but she possessed external signs of violence and prior to death seemed to have lost all her "punch." A cursory macroscopic examination revealed the ovaries still sufficiently developed to produce further eggs.

His mate no sooner dead, than the male commenced to mope, took no interest in anything, but just rested on the sandy bottom of the tank. After a lapse of six weeks a small undersized female was introduced. She was apparently quite immature, so that it came as a great surprise when she produced a normal batch of eggs within three days of her introduction into the tank.

Prior to the deposition of the eggs, the colour display by both fish was most elaborate, but the moment the eggs had been laid the female became drab and uninteresting, and the male once more commenced most as-

siduously to guard the eggs, driving the female away as before. This final batch of eggs was hatched out on January 5th, 1931, since which no eggs have been produced. The premature death of this female after a lapse of only three weeks seems rather significant and suggests deliberate intention on the part of the male to get rid of an encumbrance of which he had no longer any need.

Summary and Conclusions.

1. In captivity there appears to be but little variation in the breeding habits of the Trout Gudgeon.

2. Stimulative feeding tends to hasten oviposition, and to increase the number of eggs laid. Oviposition does not take place, however, unless the male is sufficiently energetic in his attentions, which take the form of a constant display of nuptial colouring, and, in addition, a tendency to "knead" the body of the female with his mouth. The will and the ability to deposit from 120 to 200 eggs at a time seems dependent upon such attentions, strange as it may appear, in view of the fact that fertilisation of the eggs does not take place until after they have been fastened upon a secure foundation.

3. The eggs are laid in rows which tend to converge towards the centre, and are mutually attached to one another, and to the whole batch.

4. Each batch of eggs requires on an average six days to mature, and with few exceptions the individual eggs hatch within a very short time of one another.

5. As soon as one batch is disposed of "courting" commences almost immediately and proceeds normally until the next batch of eggs is laid.

6. Comparatively few young fish survive in confinement; this is due to the cannibalistic tendencies of the female, who, without compunction, eats her own offspring; later on, however, when the male settles down again he becomes just as cannibalistic as she.

Literature.

1. BLEWETT, CLARENCE.—"Habits of Some Australian Freshwater Fishes." *S. Aust. Nat.*, 10, 1929, 21-29.
 2. GALE, ALBERT.—"Notes on the Breeding Habits of the Purple-striped Gudgeon." *Aust. Zool.*, 1, 1924, 25-26.
 3. HAMLYN-HARRIS, R.—"The relative value of Larval Destroyers and the part they play in Mosquito Control in Queensland." *Proc. Roy. Soc. Queensland*, 41, 1929.
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THE LORICATES OF THE NEOZELANIC REGION.

By TOM IREDALE, Conchologist, and A. F. BASSET HULL, Honorary
Correspondent, Australian Museum, Sydney.

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Continued from Vol. vi., p. 168.

(Plate iii.)

V. Family CRYPTOCONCHIDAE (Continued.)

X. Genus NOTOPLAX.

1861. *Notoplax* H. Adams, P.Z.S., 1861, 385. Type by monotypy *Cryptoplax* (*Notoplax*) *speciosa* H. Adams.
1878. *Macandrellus* Dall, Proc. U.S. Nat. Mus., i., 1878, 299. Type by original designation *Acanthochites costatus* H. Adams & Angas (specimen from Port Jackson, Australia).
1893. *Loboplax* Pilsbry, Nautilus, vii., 32. Type by original designation *Chiton violaceus* Quoy & Gaimard.
1928. *Pseudotonicia* Ashby, Trans. New Zeal. Inst., 58, 1927, 392, February 14, 1928. Type by monotypy *Tonicia cuneata* Suter.

Shells small to medium, broadly oval, tegmentum rather small, sculpture generally of granules, but sometimes almost smooth (*Pseudotonicia*); lateral and pleural areas confluent, rarely a dividing rib being formed of massed granules; dorsal area more or less differentiated, rarely distinctly marked off; anterior valve indefinitely radially five ribbed; posterior valve proportionately large; insertion plates large; anterior valve showing five slits, median one slit and posterior multislit; girdle very broad, varying from leathery with obscure sutural tufts, to completely spiculose with dense large tufts.

This group is difficult to define, though outstanding members have been easily distinguished as *Notoplax*, the type of which group is very notable, and *Loboplax*, whose type is also very remarkable. The girdle shows intermediates and the tegmentum also varies, so that it becomes a matter of opinion as to the limits of the groups. Ashby has unfortunately complicated matters for Neozelanic students with a series of papers on these shells, in which his rambling comments generally mutually contradict each other. Ashby suggested Iredale did not understand the characters of *Craspedochiton* when he considered it a section of the genus *Acanthochites*, yet displays his own ignorance of the essential features by describing as a new species of *Notoplax* the immature of one of his own species which he allotted to *Craspedochiton*. We cannot go into detail correcting Ashby's numerous misstatements and mistakes, but simply warn students that every one of his remarks must be carefully criticised. His value of taxonomic characters in this group is worthless, as he has described immature shells in different genera more than once, and his so-called "phylogenetic classifications" are not even amusing.

31. NOTOPLAX VIOLACEA.

(Plate iii., figs. 1, 5-8.)

1835. *Chiton violaceus* Quoy & Gaimard, Voy de l'Astrol. Zool., iii., 403, pl. 73, figs. 15-20. Tasman Bay, N.Z. Type in Paris Museum.
1836. *Chiton violaceus* Deshayes, Hist. Anim. s. Vert. (Lam.), ed. 2, vii., 519.
1843. *Acanthochaetes violaceus* Gray, Travels in N.Z., Dieff., ii., 246.

1847. *Chiton violaceus* Reeve, Conch. Icon., iv., pl. 8, fig. and sp. 41.
 1847. *Chiton porphyreticus* Reeve, Conch. Icon., iv., pl. x., sp. and fig. 56, April. New Zealand. Type in British Museum.
 1852. *Chiton violaceus* Gould, U.S. Epl. Exped., 331, fig. 420.
 1872. *Katharina violacea* Hutton, Trans. N.Z. Inst., iv., 1871, 182.
 1873. *Katharina violacea* Hutton, Cat. Marine Moll. N.Z., 50.
 1873. *Acanthochaetes porphyreticus* Hutton, Cat. Marine Moll. N.Z., 50.
 1880. *Acanthochites porphyreticus* Hutton, Man. N.Z. Moll., 117.
 1880. *Acanthochites violacea* Hutton, Man. N.Z. Moll. 118.
 1893. *Acanthochites violaceus* Pilsbry, Man. Conch., xv., 39, pl. 3, figs. 67-73.
 1897. *Acanthochites violaceus* Suter, Proc. Mal. Soc., ii., 193.
 1904. *Acanthochites violaceus* Hutton, Index Faunae N.Z., 86.
 1905. *Acanthochites violaceus* Hamilton, Col. Mus. Bull., No. 1, 36.
 1909. *Loboplax violacea* Thiele, Revision Chitonien, pt. i. (Chun's Zoologica, heft 56), 37, pl. v., figs. 13-15.
 1913. *Acanthochites violaceus* Suter, Man. N.Z. Moll., 30. Atlas. pl. 2, fig. 11, pl. 4, fig. 5.
 1914. *Macandrellus violaceus* Iredale, Proc. Mal. Soc., xi., 130.
 1915. *Macandrellus violaceus* Iredale, Trans. N.Z. Inst., 47, 1914, 425.
 1922. *Acanthochiton violacea* (sic) Ashby, Trans. Soc. South Austr., xlv., 578 (type examined ?).
 1922. *Acanthochiton violaceus* var. *papillo* Ashby, Trans. Roy. Soc. South Austr., xlv., 578 (error).
 1923. (*Acanthochiton violaceus*) Lamy, Bull. Mus. d'Hist. Nat., Paris, 1923, 260, footnote (correction).
 1924. *Loboplax violaceus* Odhner, Vidensk. Medd. Dansk. Nat. Foren. Bd., 77 (N.Z. Moll.), 8.
 1926. *Loboplax violaceus* Ashby, Proc. Mal. Soc., xvii., 16, pl. iii., fig. 1a-c.
 1926. *Loboplax violaceus* var. *dunedinensis* Ashby, Proc. Mal. Soc., xvii., 18, Dunedin, N.Z.
 1926. *Loboplax violaceus* var. *papillo* Ashby, Proc. Mal. Soc., xvii., 18.
 1928. *Notoplax* (*Loboplax*) *violaceus* Ashby, Trans. N.Z. Inst., 58, 1927, 401, February 14, 1928.
 1928. *Notoplax* (*Loboplax*) *violaceus* var. *papilio* Ashby, Trans. N.Z. Inst., 58, 1927, 401, February 14, 1928.

As there has been some doubt as to the correct determination of *Chiton violaceus* Q. & G., we reproduce their description: "*Chiton violaceus* Q. & G., Planche 73, figs. 15-16 (Le même, variété, figs. 17-20). *Chiton*, corpore ovali, convexiusculo, carnoso, levi, subrubro aut luteo, duodeviginti punctis pilosis notato; ossiculis confertis triangularibus violaceis; primo hexago. Varietas, pallio lutescente punctis rubris irrorato.

Cette belle espèce fait le passage des Chitonelles de M. de Blainville aux Oscabrelles de M. de Lamarck. En effet, ses valves sont rétrécies, arrondies, en partie recouvertes par le manteau. Elles se touchent cependant encore, mais seulement par leurs extrémités. Les grand faisceaux de poils sont remplacés par dix-huit pores fort petites, qui contiennent encore des soies qu'on ne peut voir qu'à la loupe. Les branchies ne sont point aussi longues que dans les Chitonelles; plus cependant que dans l'Oscabrelle proprement dite, où nous allons voir les osselets ne plus se toucher du moins en partie.

L'Oscabrien violet est ovale, un peu allongé, plus élargi en arrière qu'en devant, à manteau épais, charnu, lisse, d'un brun de chocolat clair, ayant, de chaque côté, près des osselets, deux petits pores rugueux. Les

osselets, moins le premier, sont en forme de selle, larges, comme ailés, leur partie saillante est triangulaire, en forme d'écusson élargi en arrière, portant, au milieu, une carène en V. transversalement striée, tandis que les côtés sont granuleux, écailleux. Les apophyses d'insertion sont beaucoup plus grandes que le disque, subarrondies avec une scissure latérale qui les divise en deux de chaque côté. Tous les osselets sont à peu près de même grandeur et de même forme, excepté les deux extrêmes. L'antérieur, arrondi, a six dents, qui correspondent à autant d'angles en relief de l'écusson, le postérieur n'en a que cinq, qui sont bifurquées. La coquille est d'un beau violet velouté en dessus, un peu plus foncé sur le triangle médian; elle est verte en dessous. Le pied est d'un jaune légèrement rougeâtre. Les lamelles branchiales, au nombre de vingt de chaque côté, occupent environ les deux tiers postérieurs du corps. Le pied est proportionnellement, étroit, et le voile buccal très-circonsrit. La variété que nous faisons figurer a la manteau jaune, avec des taches et des stries transverses rougeâtres. La coquille est plus pâle.

Il est des individus sur lesquels on ne peut voir les pores latéraux, qui sont les ouvertures de canaux aquifères, par lesquels nous avons vu jaillir l'eau que ces Mollusques absorbent.

Cet Oscabrin habite l'anse de l'Astrolabe, à la baie Tasman de la Nouvelle-Zélande.

"Nous possédons un individu, dont les valves usées sont plus larges et moins longues que dans les autres. Dimensions, Longueur 20 lignes. Largeur 13 lignes. Hauteur 6 ou 7."

This is the complete account, and it will be seen that the word "*papillo*" does not occur in any place. Ashby has written "*Acanthochiton violaceus* var. *papillo*" Type. On another card marked 'Quoy et Gaimard, 1833, N.Z.' is a dissected specimen with anterior valve missing. All valves smooth and of peculiar shape. I am rather doubtful whether this is referable to the same species. It is referred to in Voy. de l'Astrolabe at top of page 520 under the name '*papillo*.'"

This was written from notes carelessly made in a few minutes in the Paris Museum, and, although Lamy has drawn attention to the blunders, Ashby has twice reiterated his errors. We would point out then that on page 520 of the Voy. of the Astrolabe, Vol. iii., a bivalve (*Pholas globulosa*) is being described. *Chiton violaceus* appears on pages 403-05, and there is a "*varietas, pallio . . .*" which may have misled Ashby. However, "Quoy et Gaimard, 1833, N.Z.," should have warned Ashby, as both these great collectors were dead before then; neither would 1833 have been correct, and apparently the shell examined by Ashby was not related to our species in any sense, but may be *Chaetopleura papilio* Spengler.

Curiously the only synonym is *Chiton porphyreticus* Reeve, whose description reads: "Shell somewhat elongately ovate, valves punctured in the middle, verrucosely rough on each side, with a single ridge along the edge of the lateral areas, anterior terminal valve radiately five-ribbed, posterior small, blunt; cinereous purple, with a conspicuous yellow spot, dotted with black at the edge and stained with bright purple in the middle, along the umbonal summit of each valve; ligament coriaceous, spreading partially over the sides of the valves, and furnished with small tufts.

"*Acanthochaetes violaceus* Gray, Appendix to Dieffenbach's, New Zealand (not *C. violaceus* Quoy).

"Habitat: New Zealand.

"A beautifully painted species, easily distinguished by the bright purple colouring of the umbonal summit, which appears constant in all the speci-

mens I have seen; the punctures of the central portion of the valves also afford an unusual contrast with the rest of the surface which is raised in small warts."

Ashby has commented: "The Tasman Bay, Wellington, and Doubtless Bay specimens show some individual variation, but not wide differences, while those from Dunedin have the diagonal rib in the median valves ill-defined and completely granulose, and the ray-ribs in the anterior valve do not have the highly raised growth ridges common to the specimens from the other localities. If these characters are supported by the examination of a longer series, it might be well to distinguish this variety under the name *dunedinensis*."

So far the variation seems indefinite, although at first sight Ashby's distinctions appear tenable, but a series from any locality soon dispels that supposition. The specimen figured shows the anterior valve with strongly raised growth ridges, and it came from Dunedin.

32. NOTOPLAX MARIAE.

(Plate iii., fig. 35.)

- 1908. *Acanthochites (Loboplax) mariae* Webster, Trans. New Zeal. Inst., 40, 1907, 254, pl. xx., figs. 1-11. Orua Bay, Manukau Harbour, N.Z. Type ? in coll. Brookes.
- 1909. *Loboplax stewartiana* Thiele, Revision Chitonon, pt. i., (Chun's Zoologica, heft 56), 37, pl. v., figs. 8-12. Stewart Is., N.Z. Type in Paris Museum.
- 1910. *Acanthochites (Craspedochiton) mariae* Iredale, Proc. Mal. Soc., ix., 102, June (= *stewartiana*).
- 1913. *Acanthochites mariae* Suter, Man. N.Z. Moll., 28, 1080, Atlas, pl. 4, fig. 3.
- 1914. *Macandrellus mariae* Iredale, Proc. Mal. Soc., xi., 130.
- 1915. *Macandrellus mariae* Iredale, Trans. N.Z. Inst., 47, 1914, 425.
- 1926. *Notoplax (Amblyplax) mariae* Ashby, Proc. Mal. Soc., xvii., 23, April, 30.
- 1926. *Notoplax (Amblyplax) mariae stewartiana* Ashby, Proc. Mal. Soc., xvii., 25, pl. ii., figs. 1 a-c.
- 1926. *Notoplax (Amblyplax) mariae haurakiensis* Ashby, Proc. Mal. Soc., xvii., 26, pl. ii., figs. 3 a-c. Hauraki Gulf, 20 fathoms, N.Z. Type in Auckland Museum, N.Z.

Webster described this species as follows: "Shell elongated, elevated, dorsal angle about 110. Colour greenish-grey, minutely freckled with dark, latero-pleural areas crowded with flattened granules, strap-shaped or oval, as in *A. zelandicus*, all the valves being bordered with irregular, raised, white, pebble-like granules of the same type as those in *A. violaceus*, with which this species also agrees in having five prominent lobes on the anterior valve, the ribs being of white raised elongated granules, the ribs of all valves similarly marked; another characteristic feature is the presence of three almond-shaped white granules just within the posterior edge of each median valve. Dorsal areas wedgeshaped, the edges being serrated, sculptured with cuneiform lyrulae. The posterior valve has the tegmentum longer than the breadth, the hooked mucro being slightly postmedian; the area behind it is concave, white, composed of oblong granules, bordered on either side by others of longer form, but of the same colour. Anterior valve with 5 slits corresponding to the ribs; median valves with 1 slit, the posterior with many slits, the denticles being mostly bifid. In the type these denticles are perpendicular, and not visible from

above; in other specimens they extend outwards, and may be seen beyond the tegmentum; in such specimens the mucro is not so prominent, the white area narrower, and composed of long granules like those bordering the oblong granules of the type, these latter being altogether absent, as also are the raised white borders of the valves. It may be that these specimens have not attained their full development, as none of them approach the type in size. Interior blue-green, white towards the edges. Girdle grey-green, leathery, a minute pore at each suture, 4 on anterior valve. The dotted lines on figs. 5 and 7 show the limit of the white granular patch. Figs. 6 and 7 represent the posterior valve of a second specimen. Length of dried specimen, 35 mm.; width, 18 mm. Habitat: Orua Bay, Manukau Harbour, New Zealand; on rocks at low tide. Type in Coll. W. H. Webster. The type is unique; seven of the less-developed specimens were found. The apparent hybridism is striking, especially as I have never found *A. violaceus* on the west coast, though a very small form of *A. zelandicus* is fairly common."

Shortly afterwards Thiele described a shell labelled, in the Paris Museum, Stewart Island, as *Loboplax stewartiana*, but the description and figures which are here reproduced fit the "*mariae*" of Webster so completely that it was at once regarded by Iredale and Suter as synonymous.

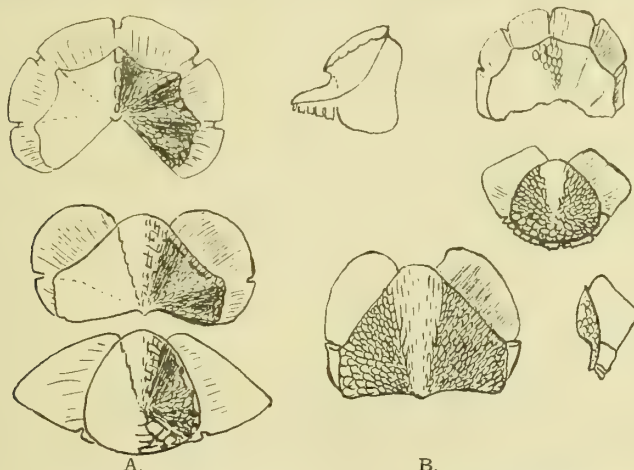


Fig. 1. A. *Acanthochites (Loboplax) mariae*, copy of Webster's figures.
B. *Loboplax stewartiana*, copy of Thiele's figures.

On account of the locality, Ashby has used the name subspecifically, but we now suggest that the locality is false and that the Paris Museum shells came from the North Island. This is quite a legitimate suggestion, as prior to Thiele's examination the collection of Loricates in the Paris Museum had been mishandled by Rochebrune, labels and specimens being disarranged and even lost. Since Thiele's time, Dupuis has continued the confusion and dispersal of specimens, so that Ashby's notes on the "types" are valueless and misleading, and no good use can be made of reference to the Loricata collection at this time. When Ashby admitted *stewartiana* as a subspecies he also proposed *haurakiensis* as a subspecies for speci-

mens dredged in Hauraki Gulf. We have examined similar shells and cannot separate them by any constant feature from the shore shell, so relegate *stewartiana* and *haurakiensis* to *mariae* absolutely until better material allows of clear distinction. It is possible that *haurakiensis* may be the same as the species Ashby later called *brookesi* whose description follows. The variation seen is at present inexplicable, and we can only hope that some student in New Zealand will attempt a study with ample material, and differentiate the species, or else unite them with reliable data. While we are prejudiced in favor of separation, we have been compelled to advocate unity.

33. NOTOPLAX BROOKESI.

(Plate iii., figs. 33, 34.)

1929. *Notoplax* (*Amblyplax*) *brookesi* Ashby, Trans. New Zeal. Inst., 60, 370, pl. 32, figs. 1, 2, 3, 4, August 29. Tauranga Harbour, 3 fathoms, N.Z.

Ashby's description is here reproduced, as this appears to be a very distinct species, but is another example of the valuelessness of Ashby's taxonomic remarks, as his good photographs show valves of a typical *Loboplax*, certainly not of an *Amblyplax*, a subgenus of his own introduction.

"General appearance: Valves reduced, girdle very broad, encroaching slightly at the sutures, anterior valve ray-ribbed, lateral area defined by a diagonal fold, dorsal area strongly raised and longitudinally lined, pleural and lateral areas equally sculptured with flat, elongate, spaced granules, coloured with mottlings varying from dark-grey to greenish-grey, thereby giving to the whole shell a greenish-grey tone. The girdle is almost unique, being densely clothed with very long, slender, adpressed white spicules, almost resembling long, white hairs.

"Anterior valve: Five ray-ribs, which are barely raised, but defined by large, flat, elongate, ovate granules, the whole valve is decorated with large, flat, ovate to subacute granules, commencing minute at the apex and increasing in size towards the girdle.

"Median valve: Dorsal area beaked, raised, whitish, with longitudinal lining, but only longitudinally grooved near the beak; this area is closely transversely grooved, and in addition is irregularly crossed by several broad growth grooves; pleural area is evenly decorated with large, elongate, subacute flat grains; these increase in size anteriorly, and towards the girdle; the lateral area is indicated by a diagonal fold, the posterior margin is recurved slightly at the girdle, sculpture is similar to that of the pleural area, except that the granules are larger.

"Tail valve: Mucro posterior of central, slope immediately behind mucro very steep, from there to the posterior margin concave, the broadly wedge-shaped portion immediately behind mucro is white, and the grains are large, circular and convex; the rest of this valve decorated with flat, elongate, ovate, subacute granules similar to the median valves, except that the granules are here less pointed.

"Articulamentum: Inside white merging into pale bluish-green towards dorsal ridge and posterior margin, slits, anterior valve 5, median 1/1, tail 11, teeth very thick in tail valve, edge blunt, sometimes notched in the middle, shallowly grooved on the outside, the insertion plate rather broader than is usual in this subgenus; sutural laminae in median and tail valves produced forward and broad, sinus between, medium, insertion plate of anterior valve broad, finely grooved on outside, teeth sharp.

"Girdle: Broad, densely clothed with adpressed, long, slender, white spicules, measuring, in complete example, 812 mmm. long by 37 mmm. at base, tapering to 25 mmm. towards the point; hair tufts composed of white, glassy, straight spicules, measuring 1,320 mmm. in length, by 37 mmm. to 50 mmm. at base, tapering to 13 mmm. at point.

"Habitat: Tauranga Harbour, dredged, 3 fathoms.

"Comparisons: As compared with *oliveri*, the insertion plate of the anterior valve is double the width, the insertion plate of the tail valve is broader and more dentate. It is easily distinguished from *oliveri*, *mariae*, and the two subspecies of this latter, *stewartiana* and *haurakiensis*, by the absence of the "comma-like" grooving of the dorsal area, and the spiculate girdle-clothing, from *rubiginosus* and *foveauxensis*, by the sculpture, consisting of flat, instead of convex grains, and the long slender spicules of the girdle-clothing. This form is nearer *Notoplax* s.s. than any other known member of this subgenus."

We have figured a specimen received from the late Captain J. Bollons, many years ago, as dredged in Hauraki Gulf, which we describe here:—

Shell elongate, valves thin, narrow, deep, flattened, back rounded, posterior valve comparatively large, girdle broad, thickly spinulose, sutural tufts prominent. Sculpture fine. Colour dull cream. Anterior valve faintly five-waved, otherwise completely granulose, granules separate, elongate oval, convex, a few larger on the waves towards the margin, apical granules very small. All median valves and posterior valve showing a well-developed distinct dorsal area, which is superficially smooth, but under a lens shows pitting longitudinally on posterior half and transverse growth-lines anteriorly. The valves are deep, the depth being more than half their breadth, anteriorly narrowing and the posterior edge wavy with apical mucro. Sculpture as in anterior valve, the lateral areas not differentiated, rarely a slight wave or a large granule or two indicating their position. Posterior valve comparatively large, mucro elevated, postmedian, postmucronal slope steep, area flattened and concave, but not otherwise differentiated. Girdle densely clothed, with fine white spicules, sutural tufts, large and prominent, their spicules very fine and long. Interior white. Slits 5-1-7-9, variable in posterior valve. Dimensions: 25 x 12 mm. (Fig. 34.)

With this specimen was another which we have also figured and here describe:—

Shell elongate, valves narrow and deep, flattened, back rounded, posterior valve proportionately large, girdle broad, thickly spiculate, sutural tufts prominent. Sculpture coarse. Colour bright orange. Anterior valve with indistinct waves, three noticeable, two lateral ones only detected by large granules; granules large, separate, varying from elongate to rounded ovals in shape, larger towards the edges, apical portion with very small granules. Median valves and posterior valve with well marked dorsal area, fairly narrow, longitudinally pitted, pits becoming obsolete anteriorly where indistinct growth lines appear. Lateral and pleural areas coalesce without distinction, the granular sculpture consisting of large convex ovals. Valves strongly narrowed anteriorly, posterior edge sinuate and mucronate. Posterior valve comparatively large, mucro postmedian, postmucronal area small and deeply concave, granular sculpture smaller than of preceding valves. Girdle broad, densely clothed with very fine white spicules, prominent sutural tufts of similar larger spicules densely packed. Interior white. Slits 5-1-7-9, variable in posterior valve. Dimensions: 18.5 x 11 mm. (Fig. 33.)

Though of different appearance, owing to the coarser sculpture, this latter appears to be conspecific, as other details all coincide, and it is more than possible that this is a variant of *mariae*, and we now only admit it tentatively. The coarse variety may be named *fortior* until the puzzles of the Neozelanic *Notoplax* and *Craspedochiton* be solved. As noted above, it is possible these are conspecific with Ashby's *N. mariae haurakiensis*, and also with Miss Mestayer's *Macandrellus oliveri*.

34. NOTOPLAX LEUCONOTA.

(Plate iii., figs. 3, 19-23.)

1912. *Acanthochites leuconotus* Hedley & Hull, Proc. Linn. Soc. N.S.W., xxxvii., 275, pl. xii., figs. 4, a-f. Lord Howe Island. Type in Australian Museum, Sydney.

The original description reads: "Shell elongated, valves carinated. Colour white, 5th and 6th median valves frequently with green spot on each side, the tip and sometimes the valve suffused with pink. Anterior valve with 5 strong radiating pustulose costae. Posterior valve similar to median valves, but without the prominent rib. Median valves; latero-pleural areas irregularly pustulose, the pustules on the lateral areas larger and less in number than those on the central areas; the areas separated by a ray of prominent pustules which increase in size towards the margin. Jugal tract not elevated, margined with pustules, V-shaped, transversely striate. Girdle broad, beset with short white spicules, and having 9 bunches of long white spicules on each side. Interior pearly-white, sinus broad, shallow. Anterior valve having 5, and median valve 1-1 slits. The posterior valve has 3 almost obsolete slits, edge thickened.

"Length: 12 mm.; breadth, 5.5 mm.

"Station: On the under side or at the edge of the insertion in the sand of small smooth stones, in pools or channels at low tide.

"Habitat: Lord Howe Island.

"Remarks: It resembles the Australian *A. costatus* in the strongly ribbed anterior and median valves, but differs from that species in the size and shape of the pustules; is broader and more elevated."

While the comparison with *A. costatus* was natural, this species shows more leaning to the New Caledonian *tridacna* Rochebrune,* in which the variation from *costatus* is exaggerated. *A. costatus* is the type of *Macandrellus*, which has precedence over *Loboplax*, when the sections are definable. Ashby's note that the species *costatus* is typically *Notoplax*, as contrasted with *Loboplax*, is, as usual, incorrect.

35. NOTOPLAX CUNEATA.

(Plate iii., figs. 2, 9-12.)

1908. *Tonicia cuneata* Suter, Trans. New Zeal. Inst., 40, 1907, 360, pl. xxviii., figs. 1-2. Bay of Islands, N.Z. Unique type in Coll. Suter, now in Wanganui Museum.
1909. "*Tonicia cuneata* Thiele, Revision Chitonen, pt. ii. (Chun's Zoological, heft 56), 72, 1910." ("Is a *Spongiochiton* = *Loboplax*.")
1913. *Tonicia cuneata* Suter, Man. N.Z. Moll., 42, 1081. Atlas, pl. 5, fig. 1.
1914. *Craspedochiton cuneatus* Iredale, Proc. Mal. Soc., xv., 130.
1915. *Craspedochiton cuneatus* Iredale, Trans. N.Z. Inst., 47, 1914, 422, 425.

* Hull & Risbec (Aust. Zool., 6, 1931, 378) used *Loboplax* for *L. tridacna*, following Pilsbry.

1928. *Pseudotonicia cuneata* Ashby, Trans. N.Z. Inst., 58, 1927, 393, pl. 40, figs. 8a, b, 9, 10. February 14, 1928.
 1928. *Pseudotonicia cuneata* Bucknill, Trans. N.Z. Inst., 59, 626, text figs. 3-4. November 30.

This species with the appearance of a *Loboplax* was placed by Suter in the genus *Tonicia*, as he thought the surface was studded with eyes. Thiele indicated from study of the radula its correct location, which was accepted by Suter, whose original description reads:—

"Shell oblong-ovate, rather small, valves much raised, the intermediate valves beaked, angled above, with cuneiform sculpture. Anterior valve with 4 low and smooth ridges with serrated margins, corresponding with the slits, anterior margin with the same number of slightly projecting lobes, posterior margin a little concave; sculpture between the riblets consisting of deeply engraved grooves and punctures, leaving numerous wedge-shaped smooth patches of various size; the whole surface dotted with minute eyes. Of the intermediate valves, the first is notably larger than the following 5, all are sinuated on the latero-anterior sides and narrowed, convex in front and prominently beaked behind; dorsal area V-shaped, smooth, microscopically transversely finely striate; pleural tracts with a few narrow longitudinal and divergent serrated grooves; lateral areas not raised, with an anterior obtuse diagonal ridge, sculpture similar to that of the head valve; the small reddish eyes scattered over the whole surface. Posterior valve with a V-shaped dorsal area, its sides serrated, mucro at about the posterior fourth, posterior slope moderately concave, posterior margin slightly lobed, the lobes corresponding with the slits, sculpture beautifully wedge-shaped, with the postero-lateral ridges corresponding with the anterior slits; the whole surface covered with minute eyes. Girdle moderately broad, leathery, yellowish, almost naked, with very few silvery fine hairs near the margin. Colour a dirty white; anterior valve with the riblets reddish white, the grooves and punctures rusty; intermediate valves with the central area light olive, bordered by white, ornamented with very fine longitudinal reddish lines; grooves on the pleural and lateral areas rusty, a few light-blue spots scattered over the areas; posterior valve having the central area coloured as the intermediate valves, the grooves rusty, the cuneiform nodules on the pleural tracts light blue; white, with a few blue spots, posteriorly. Inferior greenish-white, without any strong callosity. Anterior valve with 4 slits, the 2 central ones broader; intermediate valves with 1 slit on each side, and posterior valve with 7 inequidistant slits; all teeth of the first 7 valves finely pectinated and sharp, but those of the tail valve are stout, deeply grooved, rather blunt-edged. All the insertion plates are high; sinus flat, finely denticulate; sutural laminae angularly produced, rather thin; valve-callus not much raised. Length, 22 mm.; breadth, 11 mm. (dry specimen). Divergence 78 deg. Animal with the gills extending nearly the whole length of the foot.

"Habitat: Bay of Islands.

"Remarks: This shell is distinguished by its peculiar cuneiform sculpture from all the other species of the genus known to me. A curious feature of this species are (sic) the minute punctures scattered over the whole surface of all valves, not confined to the lateral areas, only the intermediate valves. I took them for eyes, but I may be wrong. I have only one specimen, and it is highly desirable that more examples should be obtained and carefully examined."

A note was added later. "Thiele to whom I sent a piece of the radula has come to the conclusion that the species should be classed under *Spongiochiton* = *Loboplax*."

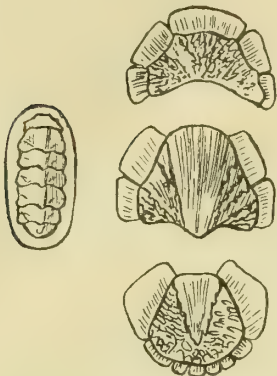


Fig. 2. *Notoplax* (*Tonicia*) *cuneata*. After Suter.

The dissection shows that in this case the external sculpture can become lost while the internal features persist. It seems to be a parallel development in Neozelanic waters of *Bassethullia** in Australian waters, the species *B. glypta* recalling the Neozelanic shell in detail, but not in general appearance. We have suggested that the Australian genus may be regarded as an offshoot of the pre-*Notoplax* stem, and we conclude that the present species stands somewhat similarly to the *Loboplax* series. The difference in status allowed by us is made with due regard to the species and genera dealt with, the variable "*mariae*" series and the perplexing "*rubiginosus*" complex, demanding less value for this offshoot than has been deemed suitable in Australia where the species appear to be much less variable and more stable.

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36. *NOTOPLAX FACILIS* sp. nov.

(Plate iii., fig. 13.)

Shell elongate, valves narrow, very deep, flattened, roundbacked, posterior valve long, girdle broad leathery, with very long prominent asbestos-like sutural tufts. Sculpture coarse. Colour greenish-grey, with a few black specks. Anterior valve small, convex, showing no waves; the median and posterior valves with very pronounced dorsal area, narrow, smooth, with transverse growth lines only; pleural and lateral areas not differentiated at all, covered with large irregularly rounded elevated pebbles, a few small ones adjacent to the dorsal area; anterior valve covered with similar pebbles, not quite as large, and beginning with small ones at the

* Pilsbry (Nautilus 41, 1928, 105, footnote) proposed this genus name for *Glyptelasma*, I. & H., preoccupied.

apex. Posterior valve with mucro at posterior fourth, the postmucronal slope steep, a little concave, pebbling a little smaller. Girdle broad, leathery, with very long sutural tufts.

Dimensions: 26 x 12 mm.

Station: Under a stone in a deep rock pool.

Habitat: Shag Point, Otago Peninsula, South Island.

Remarks: The unique specimen collected many years ago by Messrs. W. R. Oliver and T. Iredale is so remarkable that the beautiful figure here offered will make its recognition unmistakable.

xI. GENUS CRASPEDOCHITON.

1853. *Craspedochiton* Shuttleworth, Mittheil. Naturf. Gesell. Berne, 67.

Type by monotypy *Chiton laqueatus* Sowerby.

1882. *Angasia* Dall, Proc. U.S. Nat. Mus., 1881, 283, 286, 289, 290. Type by original designation *Angasia tetrica* Carpenter, Ceylon, shell not described. ? Nomen indet.

1893. *Angasia* Pilsbry, Man. Conch., xiv., 286, ex Cpr. MS. Type by monotypy *Angasia tetrica*, pl. 61, figs. 27-32 (ex Cpr. MS.), Ceylon. Not *Angasia* White, P.Z.S., 1863, 498.

1882. *Spongiochiton* Dall, Proc. U.S. Nat. Mus., 1881, 283, 286. Type by monotypy *S. productus* Cpr. Not described. ? Nomen indet.

1892. *Spongiochiton* Pilsbry, Man. Conch., xiv., 26.

1892. *Spongiochiton* Pilsbry, Man. Conch., xiv., 26. Type by monotypy *S. productus* ex Cpr. MS. described = *A. carpenteri* Pilsbry, Man. Conch., xv., 35, pl. 1, figs. 14-22. Type described from Carpenter's MS. figures. Cf. Iredale, Proc. Mal. Soc., ix., 1910, 100.

1893. *Phacellozona* Pilsbry, Nautilus, vii., 139. New name for *Angasia* *supra*.

1909. *Thaumastochiton* Thiele, Revision Chitonien, pt. I. (Chun's Zoologica, heft 56), 34. Type by monotypy *Craspedochiton* (T.) *mobiusi* Thiele.

1926. *Amblyplax* Ashby, Proc. Mal. Soc., xvii., 8, 18. Type by original designation *Notoplax oliveri* Ashby.

1926. *Lophoplax* Ashby, Proc. Mal. Soc., xvii., 11, 29. Type by original designation *Lophoplax finlayi* Ashby.

This group has puzzled and perplexed all workers, the erudite Carpenter using *Craspedochiton*, and proposing *Angasia* and *Spongiochiton* as well. Pilsbry did not recognise the association of these groups, allowing their wide separation and distinction. Little blame can be attached to this action, as Pilsbry was autoptically unfamiliar with them. Their relationship was better recognised by Thiele, who introduced a subgenus *Thaumastochiton* for a curious variation.

Ashby's attempts to deal with the series make curious reading, as having seen the type of *Craspedochiton* he recognised a congeneric species, but the same species in its immature state he allotted to a different genus. The Neozelanic species ascribed, doubtfully, be it noted, by Iredale to *Craspedochiton* Ashby rejected, and introduced two new names, one for a tailless juvenile shell, so obviously the young of the other that the error is inexplicable. Consequently, if this group can be split up, there are plenty of names available for the components.

The striking features of the true *Craspedochiton* are the short insertion plates, the Ischnochitonid sutural laminae, the multislit short insertion plate of the posterior valve and the asymmetrical girdle. The animal is very small, and when Iredale studied the series in the British Museum he even suggested that only one variable species existed, and that perhaps

even the Neozelanic shells would be included. The fact that Ashby should regard the immature as *Notoplax* and the adult as really *Craspedochiton* fully indicates the difficulties in connection with these species. Again, Ashby has drawn attention to the "fluted insertion plate, which is typical of the genus *Craspedochiton*," and then in his diagnosis of his *Amblyplax* states "insertion plate . . . fluted." As a matter of fact, the anterior valve of *Craspedochiton* figured by Ashby was from a specimen showing much "fluting," but other specimens from the same lot even, paratypes, do not show that feature strongly. The degeneration of the insertion plate of the posterior valve so pronounced in the species separated by Thiele under the name *Thaumastochiton* is easily paralleled in a series of specimens of Neozelanic shells, which up to the present have even been regarded as conspecific, some shells almost showing an unslit callus, others few slit, others many slit, but all short and characteristic.

Amblyplax was diagnosed as "Having multifissate tail valve, posterior insertion plate narrow, thickened, blunt edged, and fluted, girdle clothed with spicules or irregular, minute scales or both. Type *A. oliveri* Mestayer (MS.)." On page 18, Ashby names as the type "*Macandrellus oliveri* Mestayer," and then described the species under the name *Notoplax* (*Amblyplax*) *oliveri*; also adding to the subgeneric definition, "girdle often asymmetrical." Then Ashby, examining a minute baby shell, only 2 mm. long, with the tail valve missing, introduced a new genus *Lophoplax*, a most reprehensible action, as he admitted, "in the absence of this important part of the animal, it is impossible to determine the exact niche in the acanthoid phylum which this peculiar form should rightly occupy." The word "acanthoid" is a vulgarism of Ashby's coining, which should never have been printed, being meaningless; he paralleled it with "ischnoid," another indefensible slang concoction. The word "phylum" should not be used in Ashby's sense.

Ashby then indicates features of this baby shell which he states are "non-acanthoid," but which he had a few pages earlier described under his *Notoplax* (*Amblyplax*) *foveauxensis* of which his *Lophoplax finlayi* is undoubtedly the very juvenile. As a matter of fact, a little older specimen from the same dredging Ashby himself determined as *foveauxensis*, but his own figures prove the identity.

37. CRASPEDOCHITON RUBIGINOSUS.

(Plate iii., figs. 4, 24-32.)

- 1872. *Tonicia rubiginosa* Hutton, Trans. New Zeal. Inst., iv., 1871, 180. Off Island of Kapiti, N.Z. Type in Colonial (now Dominion) Museum, Wellington, N.Z.
- 1873. *Tonicia rubiginosa* Hutton, Cat. Mar. Moll. N.Z., 49.
- 1880. *Tonicia rubiginosa* Hutton, Man. N.Z. Moll., 114.
- 1893. *Tonicia rubiginosa* Pilsbry, Man. Conch., xv., 107. (Hutton's description copied, unidentified).
- 1897. *Acanthochites* (*Loboplax*) *costatus* Suter, Proc. Mal. Soc., ii., 194, July. (Type of *rubiginosus* only examined).
- 1904. *Acanthochites rubiginosus* Hutton, Index Faunae N.Z., 86.
- 1905. *Acanthochites rubiginosus* Hamilton, Col. Mus. Bull., No. 1, 36.
- 1905. *Acanthochites* (*Loboplax*) *rubiginosus* Suter, Journ. Malac., xii., 68, pl. ix., figs. 12-17, December 30. (Type included but Foveaux Strait specimens described).

[The above references include the type of *rubiginosus*; the succeeding ones mainly refer to Foveaux Strait specimens.]

1904. *Plaziphora terminalis* Wissel, Zool. Jahrb. Abt. Syst., 20, 679. (Error only). Suter, Nachr. D. Malak. Ges., 41, 74. Correction.
 1909. *Acanthochites (Loboplax) rubiginosus* Suter, Subant. Islands of N.Z., 1, 3. Auckland Island.
 1910. *Acanthochites rubiginosus* Iredale, Proc. Mal. Soc., ix., 155.
 1913. *Acanthochites rubiginosus* Suter, Man. N.Z. Moll., 29. Atlas, pl. 4, fig. 4.
 1914. *Craspedochiton rubiginosus* Iredale, Proc. Mal. Soc., xl., 130.
 1915. *Craspedochiton rubiginosus* Iredale, Trans. New Zeal. Inst., 47, 1914, 425.
 1924. *Craspedochiton rubiginosus* Odhner, Vidensk. Medd. Dansk. Nat. Foren. Bd., 77 (N.Z. Moll.), 8.
- [The above include any or all of the forms, but the following relate to the localities indicated therewith.]
1926. *Notoplax (Amblyplax) foveauxensis* Ashby, Proc. Mal. Soc., xvii., 20, pl. i., figs. 5a-c. April 30. ex Mestayer MS. Foveaux Strait, 15 fathoms, N.Z. Type in Dominion Museum.
 1926. *Acanthochiton foveauxensis* var. *kirki* id. ib., ex Mestayer MS. As a synonym.
 1926. *Acanthochiton foveauxensis* Mestayer, Trans. N.Z. Inst., 56, 585, pl. 100, figs. 9-12, May 5. Foveaux Strait.
 1926. *Acanthochiton foveauxensis* var. *kirki*, id. ib., 586, pl. 101, figs. 1-4. No locality given.
 1926. *Lophoplax fintayi* Ashby, Proc. Mal. Soc., xvii., 29, pl. iiii., fig. 4, pl. iv., figs. 1-4. April 30. 60 fathoms, off Otago Heads, N.Z.
 1926. *Notoplax (Amblyplax) oliveri* Ashby, Proc. Mal. Soc., xvii., 18, pl. 1, figs. 4, a-c. April 30. ex Mestayer MS. Hauraki Gulf, 20 fathoms, N.Z. Type in Dominion Museum, New Zealand.
 1926. *Macandrellus oliveri* Mestayer, Trans. New Zeal. Inst., 56, 586, pl. 101, figs. 5-9. May 5. Hauraki Gulf, 20 fathoms, N.Z.

Examination of Ashby's photographs or Miss Mestayer's drawings would allow of the distinction of the three or four or more forms that have been already named. The discrimination into their groups of a series of shells enforces a restraint as to the recognition of these species that becomes more powerful the larger the series examined. The narrow highly keeled smooth "*oliveri*" contrasts widely with the broad low rough "*foveauxensis*," while "*rubiginosus*" is narrow, highly keeled but rough. It is curious that the same kind of variation can be seen in the Australian *Craspedoplax variabilis*, where from a collection, broad low shells being the common phase, long narrow elevated shells may be picked out. In Australia we have allowed geographic variation, but in New Zealand while *foveauxensis* seems abundant in the south it is also met with in the north.

Hutton described this species as follows: *Tonicia rubiginosa*. *Chiton rubiginosus* Swains. MS. Oblong; margin slightly tomentose; valves rather elevated, sub-carinate, flattened on each side; posterior margins straight, produced into an acute central point; lateral areas indistinct, the whole surface rather coarsely granular, the granules smaller on the back. Length, .45 inch; breadth, .2 inch. Colour: Pink, getting yellowish on the back.

This species is named from a specimen from the late Mr. W. Swainson's cabinet, and now in the Colonial Museum, which is labelled as coming from the island of Kapiti. Suter then subordinated it to the Australian *costatus*, writing:—

"On examining Hutton's type specimen of *Tontia rubiginosa*, which is in the Colonial Museum, Wellington, I found it to agree with the description of *A. costatus*, and two specimens I have, which were dredged in Foveaux Straits, also belong to the same species. The specimen in the Colonial Museum has lost its colour entirely, but of my specimens one is yellowish-pink, and the other, a young shell, is most beautifully ornamented with pink, white, light-brown, and blue. The dimensions of Hutton's type specimen are: Length, 11; breadth, 5 mm. Habitat: The species has hitherto been found in Cook Strait and Foveaux Strait. In the latter locality it is found with *Chiton canaliculatus*. Very rare."

This association was incorrect, as pointed out by Pilsbry, and therefore under the name *A. rubiginosus* Suter described the same shells:—

"Shell oblong, small, subcarinate, the whole surface granular, mostly yellowish-pink, girdle with minute spines and sutural tufts. Anterior valve with five ribs which are not very conspicuous, the whole surface granulated, the granules being largest, and sometimes unequal in shape, near the margin, and decreasing in size towards the apex of the valve, which is slightly sinuated. Intermediate valves with the jugum sparsely longitudinally substriated; the pleural tracts are granular; the lateral areas, but slightly raised and not very clearly separated from the pleural tracts, are similarly sculptured, the granules being again largest near the margin, round or oval in shape. The valves are subcarinate, beaked posteriorly. Posterior valve small, the mucro central, with a smooth triangular area in front, beyond which the whole surface is granular, the granules being comparatively large. Posterior slope concave, no signs of radiating ribs. Girdle thick, fleshy, beset with microscopic white spicules; there are sutural tufts of white spicules, 7 on each side, and 4 tufts in front of the head valve. Colour: This is, as I pointed out in my former paper, variable, adult specimens showing mostly a pinkish colour, yellowish on the back, but young shells sometimes have a most beautiful colour arrangement, the granules being white, pink, light brown and light blue. The jugal tract is in the intermediate and tail valves of a darker colour, mostly reddish brown and assuming triangular shape. The girdle is light fulvous with small patches, and radiate bands of whitish-yellow. Interior white, but the centre of the valves, head valve excepted, is pink coloured; the sinus is rather narrow and deep. The anterior valve with 5 slits, corresponding with the ribs; intermediate valves with 1 slit on each side, strong teeth, and a stout valve-callous; posterior valve with a low, thick insertion plate and 4 short slits. Length, 17; breadth, 13 millim; divergence, 103 deg."

This description and the figures Suter gave accompanying this correction were drawn up from the Foveaux Strait specimens, not Hutton's type. These differed in breadth and shape, but agreed in general features, and have been the commonly accepted *rubiginosus*, as the variation was somewhat indeterminate, and most specimens were secured from the oyster beds of Foveaux Strait. When Iredale examined the Loricates in the British Museum, sets from Northern New Zealand showed shells like the Foveaux Strait form, and others, narrow and elevated, superficially different, but no good character could be found distinguishing them. These appear to be the ones separated as *oliveri* by Ashby and Mestayer.

Recently, Miss Mestayer regarded the so-called "*rubiginosus*" as separable into more than one species, and specimens were submitted to Ashby, who also separated this series. Each published their results independently.

but Ashby fortunately used Miss Mestayer's names, though his account appeared a few days earlier.

Ashby decided that the true *rubiginosus* had not since been recognised and therefore named the supposed "*rubiginosus*" as new. His effuse descriptions cannot be transcribed here, as they would only be confusing, and unfortunately Miss Mestayer's descriptions do not emphasise the salient points. Ashby's results read:—

Notoplax (Amblyplax) oliveri. Hauraki Gulf, 20 fathoms.

Notoplax (Amblyplax) foveauxensis. Foveaux Strait, 15 fathoms.

Notoplax (Amblyplax) rubiginosus. Kapiti Island, Cook Strait.

Lophoplax finlayi. Off Otago Heads, 60 fathoms.

Miss Mestayer's treatment reads:—

Acanthochiton foveauxensis. Foveaux Strait.

Acanthochiton foveauxensis var. *kirki*. No locality.

Macandrellus oliveri. Hauraki Gulf, 20 fathoms.

Consideration of the descriptions and figures given by these two workers necessitates the supposition that unless *Notoplax oliveri* Ashby differs from *Macandrellus oliveri* Mestayer, there is nothing to separate the former from *rubiginosus* Hutton.

The majority of the specimens from the oyster beds in Foveaux Strait in 15 fathoms are low and broad and coarsely sculptured, and differ superficially very much from the elevated, narrow finely sculptured shells Miss Mestayer has called *oliveri*. We have figured the two extremes and would have liked to continue their separation, but so many shells would thus become unintelligible that we are compelled to unite them temporarily.

Ashby's *oliveri* is a narrow elevated coarsely sculptured shell, and his "*foveauxensis*" from 60 fathoms, off Otago Heads, the adult of his "*Lophoplax finlayi*," shows the development from fine to coarse sculpture in the valves figured.

The insertion plates vary a little in length in accordance with the elevation of the shell, and in the least elevated the plate of the posterior valve becomes diminished so that it is scarcely recognisable save by the presence of degenerate teeth. The number varies, according to stress, as some shells show as many as thirteen small irregular slits in the posterior valve, while other may have as few as five as in the figure. The external nodulation begins as small elongate ovals and sometimes continue as such, but usually develop into larger, more convex and become more circular.

We describe hereunder the two extremes which we have figured, known as *foveauxensis* and *oliveri*.

(a). *C. foveauxensis*. (Fig. 4.)

Shell broadly oval, elevated, roundbacked, posterior valve of medium size, valves broad and fairly shallow, girdle broad, finely scaly, sutural tufts not prominent. Colour rose, median ridge darker. Anterior valve with obscure waves, indistinctly marked, granules at edge rounded, small, convex, separate, apically smaller and more elongate. Median valves with very narrow striate dorsal area, edged with longitudinal grooves, forming elongate oval pustules, which decrease laterally and become rounded on the lateral area which are elevated but not otherwise distinguished; valves

in depth about one-third their breadth, posterior edge almost straight, mucro small and not very noticeable. Posterior valve with mucro central, postmucronal area slightly concave.

A juvenile shell shows anterior waving more pronounced, sculpture more developed, granules less convex, etc., etc.

Dimensions: 19.5 x 13 mm.

(b). *C. oliveri*. (Fig. 32.)

Shell elongate, elevated, valves semi-keeled, back slightly rounded, posterior valve small, girdle broad, scaly, with sutural tufts small. Colour, brown-rose. Anterior valve with five indistinct waves not differentiated sculpturally; granulose throughout, small, well separated convex ovals, becoming larger towards the edge. Median valves broad with depth less than half their width and not narrowed anteriorly; dorsal area not separated, but sculpture less marked, being narrowly longitudinally striate, granules developing from the separated striations, and becoming broader as they are produced laterally; the lateral areas are not differentiated by means of a rib but are elevated and their sculpture is a little coarser; the posterior edge of the median valves is mucronate. Posterior valve small, mucro median, depressed, postmucronal area small and a little concave.

Dimensions: 19 x 10 mm.

It may be noticed that Miss Mestayer's *foveauxensis* is not so strongly sculptured as the shell we figure, while her variety *kirki* seems more like the form we are regarding as normal. Miss Mestayer also noted the variation in her "*Macandrellus oliveri*," and it may be that she has confused the form of *mariae* with that of *rubiginosus* which occurs there. In this respect we may note that we received specimens of *rubiginosus* (= *oliveri*) as *mariae*, but we demurred strongly from this determination, and it was not until some time had elapsed that we unravelled the mystery of the complex, some shells having been compared with *mariae* and rightly regarded as conspecific, but others from the same place were sent us which were the "*oliveri*" form of *rubiginosus*, the two not being distinguished by the sender.

VI. Family CRYPTOPLACIDAE.

This family has not yet been recognised in New Zealand proper, but enters into this place through the occurrence of a species on Lord Howe Island.

The general appearance of these Loricates is distinctive, being elongate, fleshy, with small valves and densely spiculose girdle, this feature at sight separates them from *Cryptoconchus*, whose description would read similarly. It is noteworthy that, though a feature of the tropics species are abundantly found in southern Australia, and typical valves have been found in the tertiary beds of southern Australia, indicating their long life in that region. The family has undoubtedly developed from *Cryptoconchid* ancestors, as the juveniles are very like some species of *Acanthochitonid* groups such as *Notoplax*. The valves show diminution and separation with age, and species differ in that respect also, one species scarcely showing as much tegmentum as *Cryptoconchus*. In the latter case, however, the articulamentum still remains very large, while in the *Cryptoplacidae* it also is much reduced. The insertion plates are generally

large and more or less thrown well forward, the slits becoming obsolete in all except the anterior valve, where three may still generally be seen, but remains of the other two may persist. The external sculpture is granulose in the juvenile, but becomes linear with age, a narrow dorsal area being generally well marked and smooth; the lateropleural areas inseparable; the mucro of the posterior valve commonly terminal. Girdle very large, densely spiculose, in life showing sutural tufts, sometimes apparently missing in dried shells; spicules vary in size and shape.

xii. Genus CRYPTOPLAX.

1818. *Cryptoplax* Blainville, Dict. Sci. Nat. (Levrault), xii., 124. Type by subsequent designation (Haddon Chall. Rep., xv., 1886, 37), *Chiton larvaeformis* Burrow.
1819. *Chitonellus* Lamarck, Hist. Anim. sans. Vert., vi., pt. 1, 316. Type by tautonymy *C. laevis* = *Chiton larvaeformis* Burrow.
1836. *Oscabrella* Broderip, British Cyclopaedia, ii., 31 (as of Lamarck). Type by monotypy *Chitonellus laevis* Lamarck.
1846. *Chitoniscus* Herrmannsen, Index Generum Malac., 225. New name for *Chitonellus* Lamarck.
1848. *Ametrogephyrus*, *Phaenochiton* and *Dichachiton* Middendorff, Mem. Sci. Nat. Acad. Imp. Sci. St. Petersburg., vi., 1847, 97. February, 1848. Type by subsequent designation (Iredale & Hull, Austr. Zool., iv., 1925, 101), *Chiton larvaeformis* Burrow.

[Only one genus is at present recognised in the family.]

38. CRYPTOPLAX ROYANA.

(Plate iii., figs. 14-18.)

1925. *Cryptoplax royana* Iredale & Hull, Austr. Zool., iv., 108, pl. xii., figs. 8, 16, 24. Lord Howe Island. Type in Australian Museum.
1927. *Cryptoplax royana* Iredale & Hull, Mon. Austr. Loricates, 98, pl. xi., figs. 8, 16, 24.

"Size comparatively small, valves disconnected posteriorly, but not as much as those of *C. larvaeformis* of the same size. Fifth valve large, the last five being almost all the same size, elongate and narrow. Coloration bright pink mottled with scarlet, anterior valve sometimes white, girdle white. Anterior valve elongately semicircular, ornamented with longitudinal wrinkly lines, wavy anteriorly. Median valves with smooth dorsal area, wrinkly longitudinal lines, five in number on each side; juvenile sculpture shown by two nodules. Posterior valve with mucro elevated, terminal, postmucronal slope nearly perpendicular. Girdle spicules long and pointed, striate. Interior white. Posterior slope nearly perpendicular. Dimensions: 29 x 7 mm. Station: In crevices of coral rock. Habitat: Lord Howe Island."

We have figured the anterior valve in which it will be seen that five slits appear, the three median being long, the two outside being short, a feature not otherwise noted in this genus.

EXPLANATION OF PLATE III.

- Fig. 1. *Notoplax violacea* Quoy & Gaimard, whole shell.
 „ 2. *Notoplax cuneata* Suter, whole shell.
 „ 3. *Notoplax leuconota* Hedley & Hull, whole shell.
 „ 4. *Craspedochiton rubiginosus* Hutton, whole shell.
 „ 5. *Notoplax violacea* Quoy & Gaimard, exterior of anterior valve.
 „ 6. *Notoplax violacea* Quoy & Gaimard, exterior of median valve.
 „ 7. *Notoplax violacea* Quoy & Gaimard, exterior of anterior valve.
 „ 8. *Notoplax violacea* Quoy & Gaimard, side view of posterior valve.
 „ 9. *Notoplax cuneata* Suter, side view of posterior valve.
 „ 10. *Notoplax cuneata* Suter, exterior of median valve.
 „ 11. *Notoplax cuneata* Suter, exterior of posterior valve.
 „ 12. *Notoplax cuneata* Suter, exterior of anterior valve.
 „ 13. *Notoplax facilis* Iredale & Hull, whole shell.
 „ 14. *Cryptoplax royana* Iredale & Hull, whole shell.
 „ 15. *Cryptoplax royana* Iredale & Hull, exterior of anterior valve.
 „ 16. *Cryptoplax royana* Iredale & Hull, exterior of median valve.
 „ 17. *Cryptoplax royana* Iredale & Hull, side view of posterior valve.
 „ 18. *Cryptoplax royana* Iredale & Hull, exterior of posterior valve.
 „ 19. *Notoplax leuconota* Hedley & Hull, exterior of median valve.
 „ 20. *Notoplax leuconota* Hedley & Hull, interior of median valve.
 „ 21. *Notoplax leuconota* Hedley & Hull, exterior of anterior valve.
 „ 22. *Notoplax leuconota* Hedley & Hull, exterior of posterior valve.
 „ 23. *Notoplax leuconota* Hedley & Hull, interior of posterior valve.
 „ 24. *Craspedochiton rubiginosus* Hutton, exterior of anterior valve.
 „ 25. *Craspedochiton rubiginosus* Hutton, interior of anterior valve.
 „ 26. *Craspedochiton rubiginosus* Hutton, side view of posterior valve.
 „ 27. *Craspedochiton rubiginosus* Hutton, exterior of posterior valve.
 „ 28. *Craspedochiton rubiginosus* Hutton, interior of posterior valve.
 „ 29. *Craspedochiton rubiginosus* Hutton, interior of median valve.
 „ 30. *Craspedochiton rubiginosus* Hutton, exterior of median valve.
 „ 31. *Craspedochiton rubiginosus* Hutton, elevation of median valve.
 „ 32. *Craspedochiton rubiginosus* Hutton (*oliveri*), whole shell.
 „ 33. *Notoplax brookesi* Ashby, *fortior* Iredale & Hull, whole shell.
 „ 34. *Notoplax brookesi* Ashby, whole shell.
 „ 35. *Notoplax mariae* Webster, whole shell.
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THE HABITS AND FOOD OF SOME AUSTRALIAN MAMMALS.

By ELLIS LE G. TROUGHTON, Zoologist, Australian Museum.*

There is a dual purpose in field work, that vital phase of museum activity, which involves the acquisition of nature notes, as well as specimens, but unfortunately the scant resources available frequently preclude the observation of wild life in an undisturbed state. The changing conditions and extraordinary interest of our fauna render such work of great importance, and it is a regrettable fact that on the rare occasions in the field the rush to secure adequate material in the meagre time available hardly permits an insight into the ways of the wild.

With the object of securing material from as wide a range as possible, private enthusiasts have been actively encouraged for many years by the provision of collecting gear and instructions, and, in mammals alone, these activities have yielded excellent series of known forms and occasional new ones as well. An important and very attractive phase of this association with nature lovers has been the provision of interesting nature notes which, whether sought or volunteered, have generously been placed at the author's disposal.

An instance of the valuable results secured was provided by the paper on "The Honey Mouse, *Tarsipes spenserae* Gray," in Vol. iii. of this Journal, my notes on this quaint little marsupial being based upon data and specimens supplied by a resident of the district of south Western Australia in which I had been searching for specimens. I am equally indebted to the individuals mentioned below for the privilege of recording their very interesting personal observations, and to them my sincere thanks and full acknowledgments are proffered.

Gould's Lobe-lipped Bat. *Chalinolobus gouldi* Gray.

During my absence abroad, a charming letter was received from the late Lady Cullen, in September, 1930, which detailed observations, made at her home at Leura in the Blue Mountains, of the habits of an insectivorous bat which carried on a contented existence for several weeks in a room of the house. The description supplied was so representative of the main features of *C. gouldi* as to leave little doubt of the identification, subsequently confirmed by presentation of the specimen to the Museum. As the notes are undoubtedly of great interest to students of mammalogy, apart from the keen pleasure they afforded Lady Cullen during failing health, permission was sought and graciously given to use the letter presented below in any way desired.

"Having always been interested in bats, I read with much pleasure your section on Bats in 'The Wild Animals of Australasia,' in which you mention that insufficient details of specimens are often sent you.

"An opportunity came to me lately of making a close study of an unusually pretty bat—the particulars of which I enclose. This bat was found one evening in winter, bumping itself on the walls and ceiling till it fell on the floor partly stunned. I think it must have been hibernating and was disturbed by a rat or something. Several bats were living in a ventilator, and I noticed that during the winter, if a mild night came, they

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went in search of food. The bat I am describing was picked up and brought to me. After soothing it I let it go and it flew about the room, finally hanging upside down on the bricks by the mantelpiece. At first it flew away when I went near, but soon returned, and when it got used to my voice it took flies and a moth from my hand. It camped in the same place for a fortnight, eating readily from my hand, and finally allowing itself to be picked up. It soon became a great pet, showing a surprising amount of intelligence. It only recognised my hand and that of one other person, but would have nothing to do with strangers.

"When it was running about the floor and I put my hand down as it passed, it would first sniff at my fingers then quickly scramble into my hand, moving its head about and pushing its nose between my fingers looking for food. Being winter, it was impossible to get a sufficient supply of flying insects, but I found it would greedily eat the small white grubs out of wood, beginning at the end opposite the head. It usually ate five, from half to an inch in length, then it would sleep from four to ten days. After eating it would lick its wings, clean its fur, and go to sleep in my hand. It no longer lived by the fireplace, but had moved to the window side of a curtain, a very cold place; it found its way there each night from where I had placed it when I went to bed. It also lapped water from a spoon.

"We had all become very much attached to the little animal, when, unfortunately, the family had to leave home for three weeks, and, although taken every care of (it had to be partly confined in a large basket in another house) while I was away, it was disturbed every other night to be fed, contrary to written instructions, and it was found one morning, hanging in its usual position, dead.

"It was preserved in spirit, and I will send it to you later on. This bat had quite a long tongue when extended, which we could easily see by moving the spoon further away when it was lapping water. Also, when it was eating a grub I would partly remove it from its mouth in order to watch how it managed to support it, and could see that the part inside the mouth was held by the tongue, and that the lips protruded over the part of the grub still to be eaten. All the manipulation when eating a moth and discarding the wings was done entirely by the lips and tongue, not helped by the thumbs, as I had always supposed. I had a partly tamed bat when I was a girl; I never handled it, but it lived in my room and always came when I called it, and fluttered close to my face when I went into my room at dusk, creating a good deal of interest. Only the other day someone was speaking of it, who had seen it. That bat was much larger and had big ears joined by a membrane; it also had a nose leaf.

"This bat has no difficulty in rising from the floor. I have never seen it climb up on anything to make a start. It spreads its wings, and with head down it seems to spring with its feet and the thumb-part of its wings from any flat surface. I also noticed that the bat does not seem able to smell any food at a greater distance than an inch from its nose. Experiments were made when it ran about the floor, and a moth had to be almost touched by its nose before being snatched up and eaten. Its eyesight seems to be very keen."

In response to my letter of thanks and discussion of the somewhat contradictory point that food had to almost touch the nose before being taken, though the eyesight appeared to be very keen, Lady Cullen wrote: "With regard to the sight of bats, it might interest you to know that it was a favourite amusement when I was a child to throw small pebbles about the size of a pea into the air when bats appeared in the evening and

watch their flight downward after them as they fell to the ground; from this I always thought that they had good and keen eyesight."

Though several papers have been written detailing the habits of small insectivorous bats, extending even to the temporary obstruction of sight, the data has been taken under caged conditions, so that the above notes are of particular interest in showing that a surprisingly sympathetic accord was established, while the highly sensitive creature was under no irksome restrictions and able to seek or avoid the human association at will.

Although experiment has proved that bats deprived of sight can avoid close-set objects in the dark, there would seem to be little doubt that their eyesight is quite keen, so that it is difficult to conjecture to what extent sight is employed in the search of winged prey. For instance, Lady Cullen noted that the bat had an apparently poor sense of smell as food had to be thrust close to its nose, yet she concluded that the eyesight of bats must be keen owing to their flight after pebbles thrown in the air. In "A Synopsis of the Bats of California," Hilda Wood Grinnell (Univ. Calif. Publ. Zool., xvii., 12, 1918) has detailed the more important notes published on the habits and senses of bats in a manner too full to quote for the purpose of this paper. Regarding eyesight, Hahn (1908) after extended observations, is quoted as "still unable to form any definite conclusions with regard to the importance of sight to these animals. That they can see light and darkness and moving objects is unquestionable. That the sense of sight is not highly developed is equally certain. The behaviour of some of the animals appears to indicate that at times they depend on this sense to a considerable degree, both in securing food and avoiding objects." As to the sense of smell, Hahn suggested "that since bats catch their food in the air where a flying insect leaves no permanent path and cannot be definitely localised by its odour, we must infer that the bat in seeking food does not rely on its sense of smell," and adds: "It must not be inferred that the sense of smell is lacking"; the latter point is supported by the fact that the bat tamed by Lady Cullen sniffed at her fingers before climbing into her hand.

Owing to the fact that captive bats ignored worms out of the range of vision until they wriggled, Hahn concluded that food may be perceived through tactile organs which are stimulated by air currents set in motion by the moving prey, while J. Grinnell suggests that bats hunt their insect food by sound; there would, however, be little sound or vibration from small pebbles gently thrown. Whatever may be the final conclusion, it hardly seems probable that bats would catch their elusive flying prey if deprived of eyesight, and no doubt the several senses are mutually attuned to a receptivity beyond our comprehension.

The Pigmy Opossum or Dormouse Phalanger.

Dromicia nana Desmarest.

In a letter received in 1928, Miss S. D. Bocking wrote from Lawson, in the Blue Mountains, describing a small marsupial pet for the purpose of identification, and supplied the following notes of its habits and diet.

"Eats many insects, spiders, grubs, cockroaches, etc., also sugar and water, honey, milk and sugar, and delights in the bush flowers, especially bottle brushes. . . . He will eat in one's hand and is very tame. . . . He sleeps all day but is very lively at night, running up and down the miniature trees we put in his box.

"His eyes are large and black, and his ears, also very large for his size, when sleeping are kept folded. Food is held in the two front paws, and

he sits back on his haunches with feet spread out. He also hangs by his tail, which is often carried like a spare wheel, sometimes running up it. His note is like an opossum's and he will answer us now."

At the time a request was made for further notes, and the specimen for preservation in the event of its death; in May, 1931, the little marsupial was received, accompanied by the additional very interesting notes given below.

"When I brought my tiny pet, three years ago, you asked particulars as to habits and food, and the specimen if it died. He seemed perfectly well yesterday, though he was getting very thin after his semi-hibernation, which they always appear to do twice yearly, when he was very fat. But we gave him all the foods he usually had, so apparently his span of life was over. We have always had in his house fresh gum leaves, banksias and all wild flowers in season, fresh turf and soil, sand, and berries such as black and strawberries, grapes, almost any fruit juice. Many insects, black spiders, grasshoppers, tarantulas, white earth-grubs, moths, flying cockroaches, etc. Rolled oats, bird seed, almonds, honey, and mixed sugar and water.

"Twinkle, whom we are sending, has been a great source of amusement and interest to many. Semi-dormant in day-time, feeding well at night, sometimes demolishing parts of six grasshoppers. He knew what he liked and often refused things, never attempting to touch grey garden spiders. He never appeared to care for water alone, but we usually dipped the gum leaves in water which he would lick. Some blue hyacinths were brought me once, and when put in the bunch he tore the petals down with his two little hands, darting his tiny tongue into the centre for the honey. Should we remember any other items we will let you know. Twinkle certainly looked much older than the last one brought in by the cat, so probably he was quite old when we got him."

The earliest notes on the habits of the genus *Dromicia* are found in Gould's Mammals of Australia, in which the Western Australian species, *D. concinna*, is said to haunt the flowering branches of shrubby low trees by night in search of insects and sweets, and in captivity becomes extremely active in the evening in pursuit of insects of which it is exceedingly fond. Of a local specimen, Gould wrote: "This beautiful creature was captured near St. Leonard's, North Shore, Sydney, feeding upon the blossoms of the banksias, and lived a few days in captivity. In its habits it is nocturnal. The tongue of this *Dromicia* is well adapted for sucking the honey from the blossoms of the *Banksiae* and *Eucalypti*, being furnished with a slight brush at the tip."

In "The Wild Animals of Australasia," Le Souef and Burrell record that "Those kept in captivity at Taronga Park took insects, fruits, nuts, sponge cake, biscuits, rose leaves, and eucalyptus flowers. In winter they curl themselves up into a ball and go into complete hibernation, living on the fat stored up in their tails." Some notes of Mr. A. H. E. Mattingley, C.M.Z.S., are also quoted, in which an opossum-mouse found in a dormant state in the Goulburn Valley, Victoria, curled itself into a ball, and when hung up on a twig by its prehensile tail remained hanging by that member for several hours in the dormant condition. It actually slept in the curled up position for six weeks, during which period it neither ate nor drank, so far as could be observed. On becoming active, it partook of canary seed and bread and milk and was then set free.

In 1903, Bensley, in his famous paper on the evolution and relationships of the Australian marsupials, stated that "*Dromicia* is one of the

most primitive members of the Phalangerinae, and with *Acrobates* and *Distoechurus* shows in some respects an interesting approximation to an insectivorous prototype. . . . The pes of *Dromicia nana* may be taken as representing the prototypal condition, not only for the Phalangeridae, but for all of the Australian families with the exception of the Dasyuridae," and the unreduced character and wide opposability of the hallux, or great toe, is a striking feature of this condition. According to Bensley, there is an extreme probability that the omnivorous evolution of the Phalangeridae began with diminutive animals which, like the above, were able to live among the smaller branches of trees, and to supplement their insectivorous fare with blossoms and honey. He says: "Certain of these must have continued the omnivorous evolution in a normal way, giving rise to the Phalangerinae and Phascolartinae (opossums and koala), while others resorted largely to a mellivorous habit, giving rise to *Tarsipes*. The reduction of the dentition (*Tarsipes*) is due to the same cause as in ant-eating forms, the food requiring no mastication, and its collection being perfectly provided for by the prehensile development of the tongue."

Though *Dromicia* has retained a dentition compatible with its marked tendency towards the omnivorous modifications characteristic of the larger specialised genera, upon reading the notes on *Tarsipes*, by Mr. L. Glauert, B.A. (Journ. Roy. Soc. W.A., xv., 1928), and my notes quoted in the introduction above, one is struck with the many similarities of habit in common with the highly specialised little Honey Mouse. There is a marked predilection shown for bottle brushes by both kinds of animal, while the tendency to a diet of nectar in *Dromicia* is emphasised in Gould's reference to the brush at the tongue-tip, and Miss Bocking's note of it parting the hyacinth petals and darting its tongue into the centre for nectar.

The above serves to illustrate the great importance of nature notes upon our indigenous mammals, which notes are seen to go hand in hand with the twin problems of evolution and relationship, and may often point the way to a solution of their mysteries.

The local species usually constructs a nest of soft bark in a hollow limb or crevice in a tree, while *D. concinna*, both on Kangaroo Island and in south Western Australia mostly favours the tops of grass-trees or "Black-boys" (*Xanthorrhoea*). Recently, in this Journal (Vol. 6), Mr. Norman Chaffer provided delightful notes and photographs of *D. nana*, including the interesting fact of the specimen being found resting where it had burrowed under the lining of the nest of a Yellow-winged Honeyeater (*Meliornis novae-hollandiae*). A similar resting place for the Honey Mouse has been noted by Glauert, who records the finding of three young *Tarsipes* occupying the deserted nest of the Tawny-crowned Honeyeater. Quite a coincidence, this adoption of the deserted homes of feathered fellow addicts of the nectar habit, almost inferring that the parent Honey Mice believe in the influence of environment over heredity.

• The Long-nosed Bandicoot.

Perameles nasuta Geoffroy.

The following interesting notes were supplied by Mr. J. H. Wright, Assistant Taxidermist of the Australian Museum, and provide important data, both as to the diet and method of feeding.

"The specimen was caught in a box trap baited with worms on a flat by a creek about 300 yards from the seashore at Carrs Point, Kogarah Bay, near Sydney. Kept in captivity for 19 days, it was fed on minced raw

meat, bread dipped in milk and sugared, apple, and earthworms, white grubs out of wood, and cut worms (white) out of the ground.

"Earth worms were the favoured diet, some of which were covered with about two inches of earth when being placed in the cage. Careful observation showed the following method of eating the worms. Sitting back on its haunches, the animal scratched the soil until the head of a worm was uncovered, by which it was seized and drawn from the ground; at the same time the longest fingers of one hand were run down the full length of the worm, a movement repeated by the other hand, the object evidently being to clean the dainty morsel of all grit.

"Next in preference for food came the bread and butter, dipped in milk and sugar, though the bandicoot experienced great difficulty in eating it, being rather inclined to use the same method adopted for the worms, and therefore fumbling a great deal and rolling the food in the dirt; this accumulation it continually brushed away, being in all respects an extremely clean animal."

A letter was received from Dr. F. Antill Pockley in January, 1923, commenting upon a statement in a popular nature article, attributing a mainly vegetarian diet to bandicoots, as follows: "From what I know of the animal this, though the popular belief, is erroneous. My gardens and grounds have been infested by the Long-nosed Bandicoot ever since I have lived here—over 30 years. I have trapped them and kept them in captivity for a time, to find out if there were anything in the statement that they would clear out rats—that these rodents would not come near the place if bandicoots were in the vicinity. I did not find that bandicoots kept them away, either bush rats or others.

"The holes which bandicoots scratch with their long claws in the ground are made in their search for grubs, and especially for the white larva of the Cockchafer Beetle, of which they are fond. When I baited the traps with any kind of root or vegetable I caught none, but when the late J. H. Maiden told me to bait with meat, or one of these grubs, I caught one nearly every time. When I had them in captivity they would not touch roots or any vegetable food, but ate grubs and meat. I do not say that they will not eat roots, etc., but from my experience cannot think that they are not mainly carnivorous."

There is no doubt, as indicated by the dentition and hindfeet of the family Peramelidae, in which the bandicoots are grouped, and the habits recorded for members of the various genera, that the family has evolved from an arboreal ancestral stock which was probably either purely insectivorous or only slightly omnivorous. In association with the gradual adoption of an entirely terrestrial existence, they gradually became more completely omnivorous, at which stage, according to Bensley, the dental evolution has been arrested.

In his handbook to "The Mammals of South Australia," Professor Wood Jones has supplied very comprehensive notes upon the habits and diet of several species, including the method adopted by the Short-nosed Bandicoot (*Isodon obesulus*) in dealing with the bodies of dead mice proffered as food, the long process of kneading the body into a shapeless mass with rapid strokes of the forefeet culminating in the head alone being eaten. Of the Rabbit-bandicoot or Bilby, of the genus *Thalacomys*, it is said that the tolerance shown by early colonists was due to recognition of the fact that it played a useful part in the destruction of mice and insects; and that in captivity bread or cake, meat, either raw or cooked, insects, snails, birds, and mice were all readily eaten.

Additional and very convincing evidence of the extremely omnivorous nature of the diet of the bandicoots has recently come to hand in relation to specimens of the short-nosed species, and a larger allied form, sent in from Montville, in the Blackall Ranges, north of Brisbane, by Mr. H. C. Macartney. In response to my request, the donor sent some very interesting notes, which will be detailed when the species are thoroughly worked out in a subsequent paper, but it may be noted here that Mr. Macartney is definite in stating that sweet potatoes are excavated and gnawed by the bandicoots; the tubers show unmistakable teeth marks and are an unfailing lure for the traps. This must not, however, be taken as indicating that insects are not the usual aim of the small pits dug by these animals. The carnivorous tendency is shown by Mr. Macartney having found the beak, feet, and feathers of a two months old chicken in the stomach of a large male.

In view of the marked shrinkage in range and rarity of several striking forms, one must regretfully agree with Wood Jones that the Peramelidae appear to be rapidly disappearing over the whole of continental Australia, though the coastal scrubs of New South Wales and the tropical forests of Queensland may yet prove an adequate stronghold for the local forms.

In conclusion, it may be relevant to note here, as pointed out by the late Professor Haswell, in the "Australian Encyclopaedia," that the name "bandicoot" is a corruption of a Telugu word meaning pig-rat, originally applied to a large species of rat common in southern India and Ceylon. There is no evidence to show how it first came to be applied to the Australian animal, but Collins, in 1802 (apparently following Bass in 1799), uses it without explanation as a well-known name. However, as with other foreign names which have become firmly attached to local and fundamentally differing forms, the only thing to do is to accept the inevitable gracefully, realising that it would be futile to attempt to alter vernacular names which were generally accepted as early as 1802, and that the differences are usually well understood in reference to the countries of origin.

THE 'POSSUM SEASON.

By J. E. YOUNG.

(Extracted from *The Queensland Naturalist* for July, 1931.)

Alas! The word has gone forth! An "open season" for 'Possums has been declared in this State.

The announcement was in the nature of a surprise to us, for we had been given to understand that the danger for this year had passed, but the strenuous economic period is given as a reason.

Readers will doubtless be aware that this Club has consistently fought against the far too rapid extermination of this interesting marsupial, and its cousin, the Native Bear, as well as other disappearing species.

It is to be hoped that the regulations will be rigidly observed on this occasion, especially regarding spotlight shooting and sanctuaries; for, although the gun is probably more humane than the noose, it gives the animals no chance, and an almost clean sweep is made; this is bound to include the protected "Bear," as the difference cannot well be detected with the light, and our very small remaining number of these will be sadly reduced.

Possibly some of our members may be able to advise the authorities of detected or suspected breaches of the law, with a view to action.

One is apt to wonder if the institution of some form of 'Possum farming' might not prove a solution, by which the extermination may be averted, and an industry preserved, for, though some quarters report "'possums plentiful," we know from actual experience what such reports are worth.

May the 'Possums' worst days soon be over is the hope of all true Nature lovers.

THE HARVARD EXPEDITION.

Advice was received from the Premier's Department that "the University of Harvard, Massachusetts, U.S.A., proposed to send an expedition to Australia to gather entomological, zoological, and ornithological specimens for their Museum of Comparative Zoology," and that one of the principal objects of the expedition is to form friendly relations with the various museums in Australia, to assist them, and to co-operate with Australian scientists. This Society was requested to furnish any comments or information which it desired to offer.

A reply was sent to the Premier's Department, intimating that the President and members of the Council would be very pleased to offer every possible assistance to the members of the proposed expedition in the pursuit of their objectives. It was considered desirable that types of any new species collected in Australia by members of the expedition should be, in accordance with the proclamation published by the Commonwealth Government some years ago, deposited in a museum of the Commonwealth or of the State in which they were collected.

The hope was expressed that the necessary restrictions upon collecting specimens of protected birds and animals would be treated by the State authorities in as liberal a manner as possible, consistent with a due observance of the Fauna Protection Acts.

The personnel of the expedition is as follows: Professor W. M. Wheeler, Dr. Glover Allen, Dr. P. J. Darlington, Mr. William Schevill, Dr. Ira M. Dixon, and Mr. Ralph Ellis.

The party arrived by the s.s. Ventura on the 18th August, and were welcomed at Science House by representatives of the Royal Society of New South Wales, the Linnean Society, and this Society. Professor Wheeler, in outlining the objects of the expedition, stated that the party had no intention of despoiling the wild life of Australia. It was only desired to study the curious mammals and birds of Australia, and to take back a reasonable amount of material for research work. He referred to the ancient lineage of our ants in particular, and suggested that they did not appear to have changed materially during the last 60,000,000 years. Dr. Glover Allen hoped that each State would, before it is too late, establish reservations in which both birds and mammals would be strictly protected.

It is understood that the expedition is financed by a private benefactor. Reports received by this Society from various American scientific institutions are full of records of such private benefactions to science, enabling those institutions to conduct research, not only in America, but to send out expeditions throughout the world, studying and collecting immense stores of valuable material to enrich American institutions. It is regretted that instances of similar benefactions in Australia are so few in number.



1. Tom Wren, with Harmonious Thrush on his head.



2. A Peewee posing for its photograph.

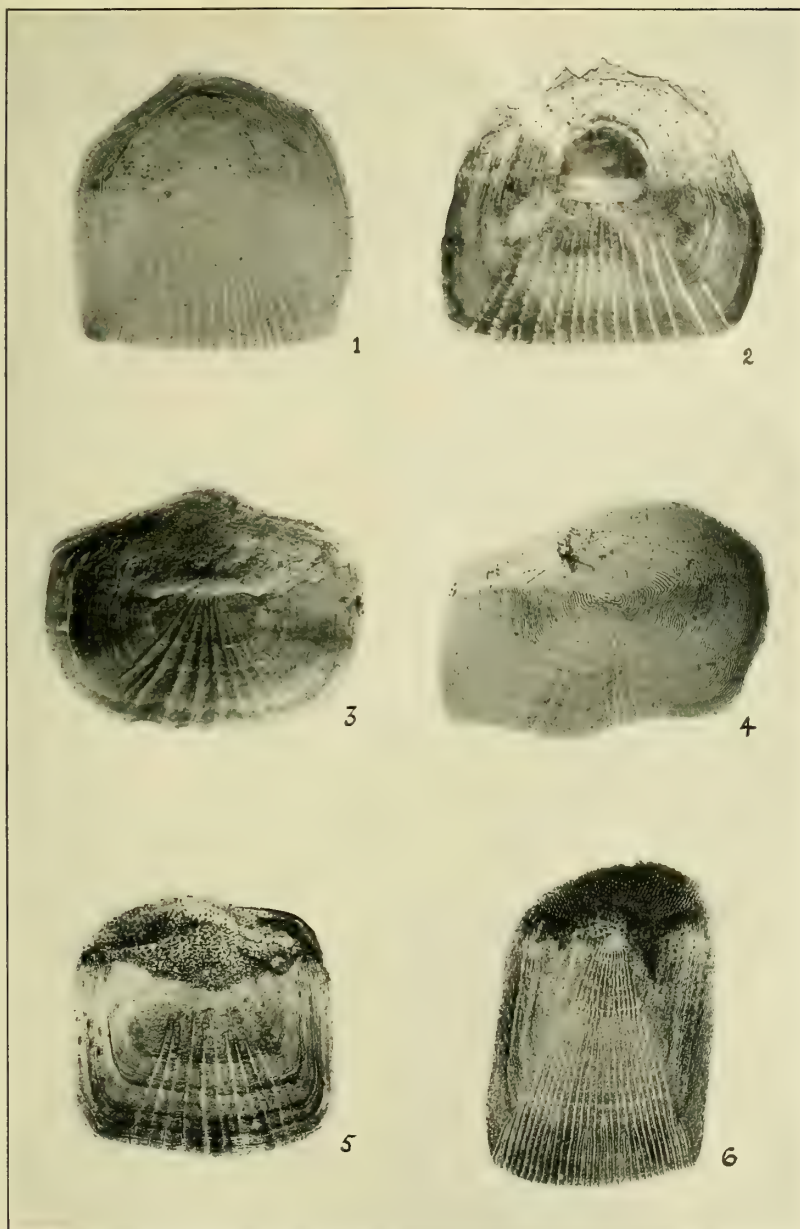


3. The Harmonious Thrush says
"A word in your ear."

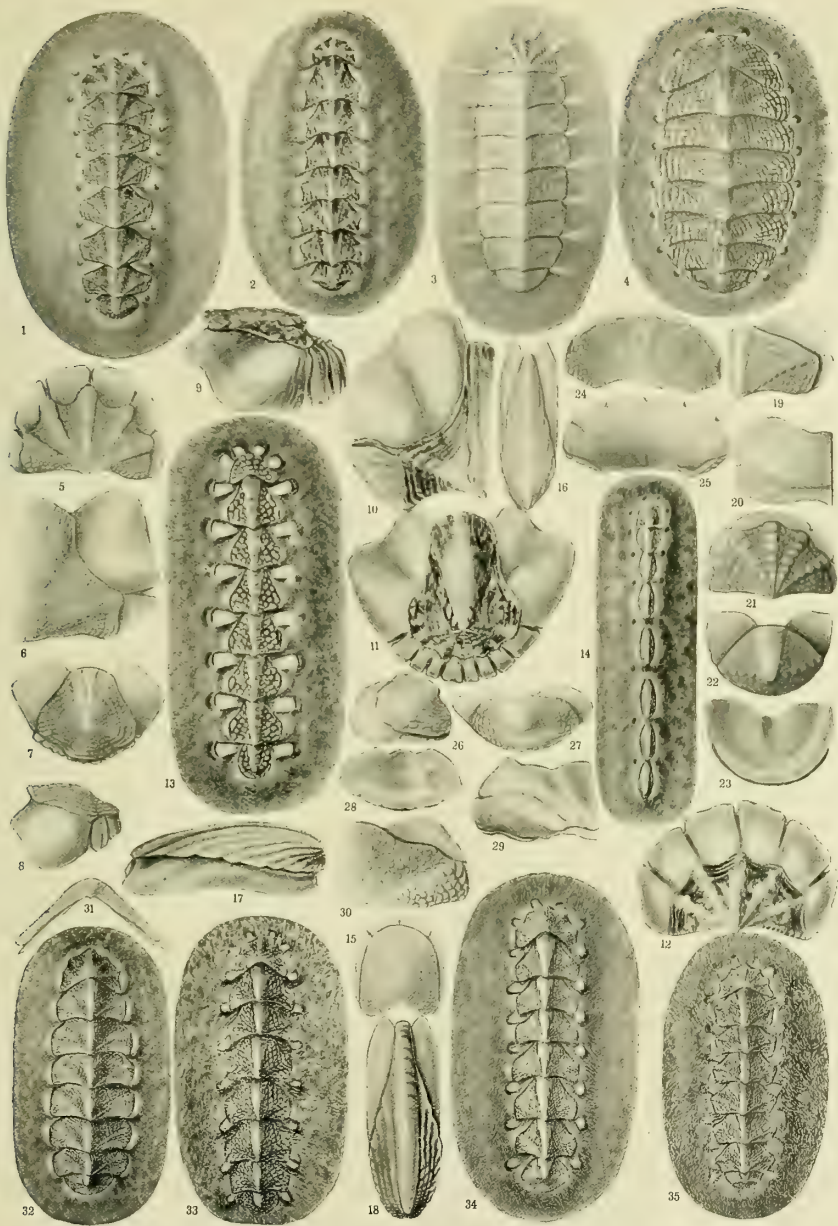


4. G. R. Gannon and the Peewee.

Photographs 1-3 by G. R. Gannon, 4 by K. A. Hindwood.



SCALES FROM AUSTRALIAN FISHES.



NEOZELANIC LORICATES.

Joyce K. Allan and Phyllis Clarke, del.

590.5944



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wood.

Royal Zoological Society of New South Wales

New Fellows.

The Council of the Society has conferred the title of Fellow upon the following members in recognition of their distinguished services to Australian zoology:—

Harry Burrell, C.M.Z.S.
Neville W. Cayley, M.B.O.U.
Professor William John Dakin.
Gustavus Athol Waterhouse, D.Sc.

New Members.

The following new members have been elected since the publication of the last list (24th August, 1931):—

Ordinary Members.—Mrs. Stuart Allan, S. S. Arnott, H. H. Baker, Miss Baker, G. Baron, R. P. Breden, J. W. Catt, R. A. Dallen, Mrs. H. E. Howes, L. B. Hart, T. H. Kelly, A. W. Keighley, G. N. Mills, Dr. C. A. Monticone, S. N. Pearson, Professor S. H. Roberts, Miss D. Shirley, Miss H. H. Semple, J. W. Turton.

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REVIEWS.

WHAT BIRD IS THAT? A Guide to the Birds of Australia, by Neville W. Cayley. Sydney, Angus & Robertson, Ltd., 1931 (12/6).

Very nearly the ideal handbook for Australian bird observers is the work before us. In a compact volume of 320 pages, royal octavo, with 36 coloured plates, and eight half-tone plates, all the 700 odd species of birds found in Australia are figured in colour; their vernacular and scientific names given, with the meaning and pronunciation of the latter; their call notes and song vocalised; their habits, food, nests and eggs briefly described. A novel arrangement (so far as Australian works are concerned) is the grouping of the birds according to their natural environment, for which the word "habitat" is used in a restricted sense. Thus the birds of the ocean, sea-shore, swamp and lake, open forest, heathland, brushes and scrubs are each grouped together, according to such environment, with subsidiary groupings into birds of the tree-tops and outer blossoms, and so forth. While this arrangement is suitable to most species, it has the disadvantage of rendering comparison of the various species of any genus difficult, where such species have adopted varying environments. However, the system has been adopted to a limited extent

in America, with acceptance, although this is the first attempt to so arrange the whole avifauna of a continent. Admirable restraint has been exhibited by the author, who has resisted a very natural temptation to enlarge upon the habits of well known species, only the essential particulars being given; thus the paragraph allotted to each species occupies nearly uniformly one-third of a page.

The illustrations are all drawn to a scale shown on each plate; they are life-like in appearance, and pleasingly varied in attitude, there being nothing stiff or formal about them. The colour printing has reached the high water mark of perfection in brilliancy and accuracy of register, and the half tone plates illustrating the various classes of environment are from excellent photographs taken by Australian observers. Mr. Cayley, as both author and artist, has certainly produced a work unique in that respect; that he fully acknowledges his indebtedness to several fellow ornithologists and bird observers for assistance in preparing the letterpress does not in any way lessen the debt we all owe to him for the wonderful book he has given to the bird-lovers of Australia.

AN INTRODUCTION TO THE LITERATURE OF VERTEBRATE ZOOLOGY. Compiled and Edited by Casey A. Wood, M.D., LL.D. London. Oxford University Press, 1931, £3/3/-.

This very handsome volume of 644 pages, quarto size, contains a comprehensive review of the beginnings of zoological records from those of Aristotle onwards, including not only Greek and Roman authors, but Arabian and Chinese writers on vertebrate zoology. The mediaeval writers; the Renaissance and its effect on the records of zoological science; reports of voyagers and naturalists; the forerunners, contemporaries, and followers of Linnaeus, and the modern exponents of the science are all ably summarised in this volume as an introduction to the main work, which consists of a series of indices to the contents of the Blacker, the Emma Shearer Wood, and other libraries of the McGill University, Montreal. A beautiful reproduction in colour of an aquarelle of the Dodo, attributed to Charles Collins (*ca.* 1736) forms a frontispiece to a volume which should find acceptance in every zoological library. Dr. Casey Wood will be remembered by many Australian zoologists, who had the pleasure of meeting him on the occasion of his visit to Sydney in 1922. He is an authority on birds, and is Collaborator, Division of Birds, Smithsonian Institution,

AUSTRALIAN NUDIBRANCHS.

By JOYCE K. ALLAN,

Assistant in Conchology, Australian Museum, Sydney.

(By permission of the Trustees, Australian Museum.)

(Plates iv. and v.)

Those who have had experience in collecting nudibranchs, or sea-slugs, know the disappointment that always accompanies their preservation, when their beautiful colours and shape rapidly go. This is probably the reason why the study of this group has been neglected more than that of any other group of molluscs. Much of the earlier work on the group is based on preserved specimens taken from Australia by early zoologists and naturalists attached to expeditions to this part of the world, so that material from the same regions was sometimes described by systematists working independently in different countries. Moreover, in many cases new species were described without figures and from specimens of which the locality and colour were unknown, so that the earlier names and descriptions require to be revised.

The only work done locally in the earlier days was by George French Angas, who made water colour sketches from life of Sydney nudibranchs, which he collected while residing there. Many of these were new and were published, with descriptions, by Crosse, in *Journal de Conchyliologie*, Ser. 3, Tom. 4, 1864, p. 43. This useful paper is excellent for identifying some of the commoner nudibranchs of Sydney Harbour.

Basedow and Hedley (*Trans. Roy. Soc. S. Austr.*, Vol. xxix., 1905) give a list of the known Australian nudibranchs, with remarks on, and descriptions of new South Australian species. They also give a historical sketch of the early collectors and authors. Since then no additions of importance have been made to this list.

For some years Risbec has worked extensively on the nudibranchs of New Caledonia, but few of the species he has dealt with so far resemble the northern Australian ones.

It is my intention, therefore, to publish from time to time notes on species of interest which are already in, or come to, the Museum collection. Some unidentified species in the collection have entirely lost their colour, and therefore I think it wiser to leave these as doubtful species until others are obtained from the same localities.

Several specimens collected locally in the last few years and brought alive to the Museum have enabled me to make colour sketches and notes of the living animal for future reference.

The recent expeditions to the Great Barrier Reef, Queensland, have been most profitable, and the collections made have included many new and interesting slugs. These are accompanied in most cases with notes on their habits and colours, which have considerably helped me in their identification.

When living specimens are studied, all the species so far met with have been identifiable at sight and very little variation has been found in them.

I wish to thank Mr. Melbourne Ward and members of the Museum staff for their kindness in collecting sea-slugs for me at every opportunity, and, in particular, Mr. G. P. Whitley, whose notes and figures of the live animals he collected have been of great assistance. I am also indebted to Mr. T. Iredale for the help he has given me in preparing this paper, and

to the Director of the Taronga Zoological Park for allowing me to keep material in the Aquarium and to study sea-slugs collected and placed there by members of the aquarium staff.

Genus DISCODORIS Bergh, 1877.

Discodoris Bergh, Jahrb. deut. Malak. Gesell., 1877, 61. Type designated by O'Donoghue (Trans. Roy. Canad. Instit., No. 34, Vol. xv., Pt. 2, 1926, 207), *Discodoris boholiensis* Bergh, Malac. Unters. Semper. Reisen Archipel. Philipp., 1877, 519. Bohol, Philippines.

Flat, oval or elongate-oval animals, their surface finely granulose or tubulose, but smooth to the touch and much softer than *Platydoris*. The mantle and foot are fairly broad. Rhinophores retractile; branchiae generally six in number, retractile into a rounded, sometimes stellate cavity. Foot is grooved and notched on the upper lip. They have an extraordinary habit of discarding portion of, or the whole of their mantle when handled to any extent. The remaining part of the animal appears able to live for some days without this discarded portion. The Discodorids are almost world-wide in their distribution, and are often found under stones or coral reefs. In colour they are generally yellow or light brown, with darker markings.

DISCODORIS WHITLEYI, n.sp.

(Plate iv., figs. 1 and 2.)

Animal elongate-oval, squarish at the anterior end, and rounded posteriorly; body very soft, mantle ample and inclined to break away from the central portion. Whole surface covered with minute granulations, which are inclined to rub off in the preserved specimen. The tentacles are conspicuous, club-shaped and laminated on the upper portion, and are retractile into large rounded slightly raised cavities. The branchial plume consist of six tripinnate branchiae, retractile into a large rounded and slightly raised cavity which is not divided into definite lobes. They are set round a tubular elongate anus, which protrudes between the two posterior gills.

The foot is widest anteriorly, tapering to a more rounded shape posteriorly, the tail projects a little beyond the mantle edge when the animal is crawling, although in preserved specimens it shrinks up and does not give this idea of projection. It is fairly broad, with slightly crenulated edges. The upper lamina is conspicuously divided, and the oral tentacles are long and linear.

The general colour of the animal in life is yellowish cream, with irregular sized patches of dark brown colour scattered over the whole of the dorsal surface. These patches, which are smaller, though more numerous towards the margins, are composed of stipulations of dark colour, and are easily rubbed off in the preserved specimens. The club-shaped portion of the rhinophores is rich black, and the lower portion whitish. The stems of the branchiae are the same, yellow-cream, as the body, veined and tipped with dark brown, and when protruding slightly from the branchial cavity appear very dark. Under surface slightly paler than the upper, the only contrasting marking being numerous irregular sized small dark brown patches along the under marginal end of the foot.

Dimensions: Length, 40 mm. Breadth, about 16 mm. in life.

Locality: North West Islet, Capricorn Group, Queensland. Type specimen (C. 57,205), Australian Museum collection.

Two specimens of this easily recognised animal were collected in May, 1931, by Mr. G. P. Whitley, after whom I have named it, and who kindly made excellent colour notes and a sketch of the larger one for me while it was alive. These have been most helpful to me in preparing my drawing and description, as the specimens have considerably lost their colours and character after only a very few weeks in preservative.

Genus *PLATYDORIS* Bergh, 1877.

Platydoris Bergh, Jahr. Malak. Gesell., 1877, 73.

Very flat, oval-shaped animals, with a peculiar hard leathery texture. The dorsal surface is minutely granulated and rough to touch. The branchiae are five, six or seven in number, tripinnate, and retractile into a cavity, which is usually divided into a corresponding number of lobes, and which converge together when the branchiae are retracted. The foot is narrow and grooved in front. They are almost world-wide in distribution, and are found under stones at low tide on coral reefs, where they wedge themselves into rock crevices, often assuming the shape of the crack in which they live. Very lethargic in their movement, and common in tropical seas.

Iredale and O'Donoghue (Proc. Malac. Soc. Lond., Vol. xv., Pt. iv., 1923, 195) point out that Bohadsch (Anim. Mar., 1761, Cap. iii., 65-74, Taf. v., figs. 4-5) made the genus *Argus*, which he did not specifically name, but described well, and which *D. argo* was based upon. This genus was later named *Platydoris* by Bergh, on the contention that *Argus* Bohadsch, was not available. Under the present rules they consider that *Argus* must be accepted instead of *Platydoris*.

I have seen Bohadsch's description, and I find that my species agree more with Bergh's description of the genus *Platydoris* than with that of Bohadsch's *Argus*, so prefer to leave them under the former generic name.

PLATYDORIS IREDALEI, n.sp.

(Plate iv., figs. 3 and 4; plate v., fig. 3.)

Body oval, firm, leathery, flattened, mantle wide, with edges slightly crenulated, dorsal surface smooth to touch, but very finely granulated, with minute out-tubercles. Rhinophores with bulbous tips completely retractile into deep cavities, margins of which are raised and denticulate, laminated. Branchiae six, completely retractile, set round an elongated, thin tubular centrally placed anus; cavity margin formed of six irregular-sized contractile lobes, the direct anterior and posterior ones being the largest. Foot narrow, rounded in front and behind, wider posteriorly than anteriorly, about one-fourth the width of the body, and extending further towards the anterior than the posterior margin. Shallow groove in front, upper lamina a little enlarged and divided medially. Oral tentacles small, flat, and rounded.

Colour in spirit light creamy brown, with cloudings of dark brown intergranular markings. This marking is in some specimens very dark and in others lighter, and forms dark irregular network patches which are easily rubbed off the preserved animal. Branchiae same pale colour streaked with dark brown. Rhinophores pale yellow.

Undersurface has ground colour as above, perhaps a little paler, sole of foot same colour as the mantle expansion. The sides of the foot are closely and minutely speckled, with the dark granular speckling which appears on the dorsal surface. This is the only marking appearing on the under-surface.

Dimensions: Length of spirit specimen, 90 mm. Breadth, 60 mm.

Habitat: Masthead Reef, Capricorn Group; Green Island, off Cairns, Queensland (coll. C. Hedley); Michaelmas Cay, off Cairns, North Queensland (coll. T. Iredale and G. P. Whitley); North-West Islet, Capricorn Group, Queensland (coll. G. P. Whitley and M. Ward).

Type specimen, Masthead Island (C. 19,088) in Australian Museum collection.

I think I am justified in giving a new name to this species from Queensland, which Basedow and Hedley (Trans. Roy. Soc. S. Austr., Vol. xxix., 1905, 140) recorded from Queensland as *Platydoris coriacea* Abraham, (P.Z.S. Lond., 1877, 247), an identification which does not satisfy me, as Abraham describes his species from Seychelles, South Africa, and Sir Charles Hardy's Islands.

In a footnote to his descriptions of new species in this paper, Abraham observes that a few of the descriptions may relate to forms already named by other observers, and adds that none of the hitherto published diagnoses can be definitely referred to any of the animals about to be described by him. Basedow and Hedley note that *P. coriacea* Abraham, is suspiciously like *P. scabra* Cuvier (Cuvier, Ann. Mus. d'Hist. Nat., iv., 1804, 466, Timor). Cuvier's description is slight, and as no figure is given is rather unsatisfactory. Basedow and Hedley probably based their decision on Quoy and Gaimard's figure and description (Quoy & Gaimard, Voy. de l'Astrolabe, 1832, pl. 18, figs. 1-4) of a species found at Tonga, New Guinea and Vanikoro, to which they doubtfully give the name of *P. scabra* Cuvier.

Mr. Whitley, on his recent trip to North-West Islet, kindly made colour notes of the live specimens to compare with the illustration of Quoy and Gaimard's species. He found the former was much the same colour in life as when preserved—perhaps a little darker. The ground colour was dirty creamy-white, with smoky grey-brown patches irregularly disposed over the surface. The rhinophores are light brown-yellow at their bulbous tips. The undersurface is creamy-white, except in the crevice between the foot and the mantle, which is thickly dotted with grey-brown speckling.

The foot is not bright yellow, with lavender sides, as in Quoy and Gaimard's figure, of the species they doubtfully call *P. scabra* Cuvier, nor are the rhinophores red-tipped, and the whole surface has not the lavender tinge over it, but has a definite creamy-brown appearance.

The specimens Mr. Whitley collected were found tightly wedged in rock crevices, their shape coinciding with that of the crack in which they lived, and were most difficult to detect, as they closely resembled the colour of the surrounding rock.

According to his footnote, Abraham did not consider his species similar to that of Cuvier, and Basedow and Hedley preferred to identify the Masthead Reef and Green Islands specimens as *P. coriacea* Abraham, instead of *P. scabra* Cuvier, and, although they noted a similarity between these two species, by preferring Abraham's name, they must have found that species compared more favourably with theirs than the former did. Also, Quoy and Gaimard's species may not even apply to that of Cuvier, who has made identification difficult through the want of a figure and a better description. As the Platydorids are so alike in texture and shape, the colour plays a large part in the differentiation of species, and once that has vanished many species would be hard to separate. As Abraham made no dissections, the specimen he records from Sir Charles Hardy's Islands may be similar to the Queensland ones under discussion, but through preservation may be superficially like the South African and Seychelles specimens.

I prefer to leave the name *P. coriacea* Abraham, for the South African, and the Seychelles species, *P. scabra* Cuvier, for the species of Cuvier, and, perhaps, of Quoy and Gaimard, and for the Queensland specimens propose the new name *iredalei*.

PLATYDORIS CAPRICORNENSIS, n.sp.

(Plate iv., figs. 5 and 6.)

Animal small, flat, subcircular. Mantle with widely extended border. The presence of numerous close minute subequal tubercles give a granulated appearance to the dorsal surface. Rhinophores clavate, retractile within deep cavities, the margins of which are well raised and crenulated. The portions of the rhinophores showing in the cavities have well-marked laminations, which probably extend along their upper halves. Branchiae six, tripinnate, set round a long thin tubular anus, the contractile cavity containing them having a six-lobed margin. Oral tentacles short, flat and wide at their base. Foot fairly narrow, width about one-third that of the animal; rounded at both ends; shallow transverse groove at anterior end; upper lamina divided centrally.

The colour of the spirit specimen is, in general, orange-tan, with a reddish underlying tinge. On the upper surface are two definite rows of irregular sized black-brown patches of colour encircling the animal. These patches are formed by minute speckling of dark colour, situated between the granular tubercles. In the centre of some of the patches the colour has weakened, leaving the outer edge dark, and in some places having a dark ring only. Between these two rows, smaller patches are scattered. The markings are confined principally to the mantle and the lower sides of the body. They are absent on the central dorsal surface, except for a slight suggestion of colour in front of the branchial plume.

Undersurface same colour as above. No dark blotches present, except a very faint suggestion of the dark colour on the sides of the foot posteriorly. Rhinophores lighter in colour, tips orange. Branchiae pale, streaked and tipped black-brown. Oral tentacles pale yellow.

Dimensions: Length of spirit specimen, 20 mm. Breadth, 16 mm.

Habitat: North-West Islet, Capricorn Group, Queensland.

Type specimen (C. 57,207) in Australian Museum collection.

Described from a single specimen collected by Mr. Melbourne Ward in May, 1930. No colour notes were made at the time, but it was probably much richer and darker in colour when alive. As this beautiful little specimen shows all the external characters of the genus *Platydoris* Bergh, and lack of other specimens prevents me making a dissection at present, I have placed it in that genus.

Genus *Dictyodoris* Bergh, 1880.

Dictyodoris Bergh, Reis. Arch. Phil., Bd. ii., Pt. 3, Suppl. 1, 1880, 75-78; L.C., Bd. ii., Pt. 2, 1103.

Oval-shaped animal, with wide mantle, texture rather leathery, but surface smooth. Branchiae few, usually four, small, bi-pinnate, and retractile into a rounded cavity. Rhinophores retractile. Foot only slightly grooved in front, or not at all. Back ridged, the main ridges often bearing large tubercles.

Dictyodoris aurantiomaculata, n.sp.

(Plate iv., figs. 7 and 8; plate v., figs. 8-10.)

Body broad, rounded anteriorly and posteriorly, elevated in the centre, fleshy, mantle edges thin, surface smooth to touch. Along each side of the

dorsal central portion is a row of large elongated pointed fleshy protuberances, which in the live specimen are very erect. A dorsal medial ridge extends from anterior to the rhinophores to half-way between the branchial opening and the posterior mantle margin, commencing and ending with a protuberance and with three large ones arranged along it, each one placed about half-way between those on the side rows. The elevated protuberances and the raised ridges formed by the medial line roughly divide the central dorsal area into five slightly sunken compartments.

From each side of the first anterior protuberance a fleshy ridge runs out towards the mantle margin and on both sides of the dorsal surface; a similar ridge runs from each of the protuberances to the side mantle margins, and from each posterior one, situated on either side of the branchial opening, two ridges run, one to the sides, and one to the posterior margin. A ridge connects the extreme posterior medial protuberances with the branchial opening and the posterior mantle margin.

The branchiae and rhinophores are completely retracted in the single specimen found. The opening of the former is small, with regular non-elevated edges. Those of the latter are close together, on either side of the central ridge, and are round and raised. The branchiae, four in number, are very small and stumpy, with a broad rachis, and are divided at their tops into about five small groups. They are situated two on either side of the tubular anus, and the two posterior ones are partly divided into two a little way from the tops. The undersurface of the animal is smooth, with a narrow small foot, which does not extend to the margins. It is broadly rounded anteriorly and slightly narrower posteriorly. Lip well divided, upper lamina forming wide lobes. Oral tentacles conspicuous, linear and narrow at the apex.

A vividly coloured and most conspicuous animal, with the ground colour milky opalescent, and the upper surface covered with rich orange-yellow lines, and large irregular-sized oval spots of the same colour, outlined with deeper orange. Along the medial ridge runs a yellow band, interrupted by the fleshy protuberances, which are milky-white, with yellow tops. A similar yellow line extends along the ridges from the protuberances along the sides, broadening as they approach the outer edge of the margin, which is edged with yellow. The raised upper portion of the dorsal surface is outlined with interrupted orange lines, and the branchial and rhinophore openings are encircled with similarly coloured elongated markings.

Between each raised ridge on the mantle are roughly three very large oval spots in a row with much smaller ones on either side of them, growing smaller near the margins. A rich lavender-blue tinge shows through the central portion. The tips of the branchiae and rhinophores seem light brown. The undersurface is the same ground colour as the upper, with the edges of the mantle and foot outlined with orange-yellow. The tips of the oral tentacles are also orange-yellow. The spots on the upper surface faintly show through on the border of the undersurface.

Since preparing the above description of the preserved specimen, I have examined a photograph of the live animal taken by Mr. M. Embury when it was collected. It had not apparently had time to change to any extent in preservation. In the photograph, the protuberances were longer and more erect, and the large and small spots seemed to be situated on the tops of soft blister-like pustules. In the preserved specimen, this effect was noticed on the mantle just below the raised central portion, but out toward the margin the tendency disappeared, leaving only coloured spots. The

tips of the rhinophores were peeping out, but the branchiae were retracted beyond sight. Both Mr. A. A. Livingstone and Mr. W. Boardman, who brought the specimen back from North-West Islet, told me they did not at any time see the branchiae exerted.

Radula light yellow coloured, about 42 rows hooked, crowded and slightly denticulate teeth, increasing in size outwards. Formula, 54.0.54.

Dimensions: Length in spirit, 77 mm. Breadth, 56 mm.

Habitat: Brought back to the Australian Museum by Messrs. A. A. Livingstone and W. Boardman from North-West Islet, Capricorn Group, Queensland, where it was collected by Master Embury in January, 1931. Type specimen, C. 57,208.

I experienced difficulty at first in determining the genus for this species. The soft raised ridges with lines of colour seemed to ally it with *Halgerda* Bergh, but the branchiae differentiated it. Eliot (Proc. Malac. Soc., vi., Pt. 4, March, 1905. 229), describing species of *Dictyodoris tessellata* Bergh, from Madagascar, adds that he thinks that genus should be united with *Halgerda* and which seems to have priority of name. His specimens have three dorsal ridges, bearing three or four tubercles, which are connected by secondary ridges extending towards the margins. The margin is outlined with a coloured border. The main character, however, is the four branchiae, two on each side of the anus, and each with a thick rachis. These are similar to the branchiae in the North-West Islet species. I prefer to place my species in the genus *Dictyodoris* Bergh, rather than in *Halgerda* Bergh.

Genus ASTERONOTUS Ehrenberg, 1831.

Asteronotus Ehrenberg, Symbolae physicae, 1831, not paginated, but on p. 97; Bergh, Jahr. Malak. Gesell., iv., 1877, p. 45, 161.

Oval animals of large size, with a very leathery texture. The dorsal surface is quite smooth, but bears large ridges and lumps. The branchiae are large and bushy, five to six in number, and are retractile into a cavity, which is usually divided into a corresponding number of convergent lobes. Rhinophores retractile. Foot broad, upper lamina divided generally into flaps. Mouth large.

ASTERONOTUS BRASSICA, n.sp.

(Plate v., figs. 12-14.)

Animal very large and heavy, with rounded elongated mantle, widely extended and thin towards the edges and irregularly shaped in places. Dorsal surface covered with ridges and large pustules. A wide raised ridge extends down the centre of the dorsal surface from between the rhinophores and terminating near the branchial plume. From this ridge, wide globular ridges extend towards the margins, about three on each side, which after preservation partly divide into large protuberances. A row of large blister-like protuberances extend down the sides of the dorsal central portion parallel to the median line. Round the marginal edge are rows of narrow parallel ridges which break up here and there into small pustules. Rhinophores large and retractile into ample cavities, with raised crenulated edges. Branchial cavity large and raised with six convergent lobes; branchial plume very conspicuous, bushy, six-gilled and retractile to about level of lobes. Foot broad and long, extending well down towards posterior end, truncate anteriorly, narrow and rounded posteriorly. Upper lamina divided; formed into two large flaps. Mouth very large, inner portion sometimes protrudes. Oral tentacles large, flat and leaf-like.

Colour bright cabbage-green, with margins and surface of lumps

lighter in tone. Narrow marblings of lavender-blue are along the sides of the central ridge and encircle the larger protuberances. Gills light brown; rhinophores greyish-green. Undersurface light greenish-yellow; foot more brown than the mantle. Encircling the foot on the mantle is a broad band of dark colour. A margin of confluent blobs of the same dark colour extends round the mantle edge.

Odontophore, dark coloured and broad, with 41-43 rows of hook-shaped broad teeth elongated at their base. Formula, 54.0.54.

Dimensions: Length in spirit, 155 mm. Breadth, 115 mm. (Average specimen). In life much larger.

Locality: Numerous specimens collected between May, 1930-May, 1931, by Messrs. A. A. Livingstone, W. Boardman and M. Ward, at North-West Islet, Capricorn Group, Queensland. Type specimen (C.57,210) in Australian Museum collection.

This species resembles somewhat the description of *Asteronotus mabilla* Abraham (P.Z.S., 1877, 249, pl. xxviii., figs. 1-4, from the Seychelles and Samoa), but is much larger than it and has larger though fewer protuberances and ridges. On the undersurface of *A. mabilla* there is only one dark coloured band which is exactly half-way between the foot and the mantle edge. The definite two bands of the North-West Islet specimens are situated immediately round the foot and round the mantle edge. The odontophore in the former is about 26 rows, as against 41-43 in the latter.

Basedow and Hedley (Trans. Roy. Soc. S. Australia, Vol. xxix., 1905, 141) placed *A. mabilla* Abraham, on the Australian list from Sydney Harbour. I have examined this specimen, which is in the Australian Museum collection, and have found it smaller, narrower and flatter than the northern one. Its original colour has completely gone, and it is now a pale cream all over, including the branchiae. The dorsal surface is covered with small pustules, as in Abraham's figure, and not large ridges and protuberances, as in the species described above. I am doubtful, however, whether this specimen came from Sydney Harbour. It has apparently been in the collection for many years, and the only data supplied is "Port Jackson" on a small label. As the nudibranchs hitherto found in that locality have been only small ones, I think that the late Charles Hedley would have made some reference to it in that, or some other paper, if such a large one had appeared. Knowing how well he always labelled material, especially if collected by himself, the insufficient data on the label makes me think that it was collected elsewhere, with other material, and had become separated from it. It is remarkably like a single specimen of *Asteronotus* in the collection from Port Darwin, Northern Territory, which is the same pale cream colour.

Mr. A. A. Livingstone collected a single specimen at Cape Leveque, W. Australia, 6 in. x 4 in. in size, resembling somewhat the North-West Islet ones, but it has only a single extremely broad dark band of colour round the foot, extending from the margin of the foot almost to the mantle border. There are, besides, only five branchiae in the five-lobed cavity, and the foot is narrower than the former species. To me it seems to resemble more the figure of *Asteronotus cespitosus* (Van Hasselt) (Notes of the Leyden Museum, Vol. ix., 1887, 307, pl. 6, fig. 9) from Java, a browner species than the North-West Islet one, a fact which Mr. Livingstone also noticed in his live specimen, and the sculpture seems smaller and more compact. The specimen has lost its colour far more rapidly than the Barrier Reef ones, although preserved in the same manner. Until I see

more specimens of it, I cannot say whether it is a variety or the same thing.

There is a possibility that the specimen collected by Mr. Livingstone at Cape Leveque may be an adult form of O'Donoghue's *Asteronotus fuscus* from Abrolhos Island (Journ. Linn. Soc. Lond. Zool., Vol. xxxv., 551, pl. 28, figs. 12-13). This species is only 27.5 mm. long by 15 mm. wide, has five branchiae, is muddy brown colour in spirit, and in life dirty brown, with some lighter brown spots.

ASTERONOTUS WARDIANUS, sp. nov.

(Plate iv., figs. 16 and 17.)

Body rather large, flat, elliptic. Mantle with wide extended border, thin at the edge; dorsal surface smooth, and, though flattened somewhat with preservation, shows irregular-sized blister-like pustules, becoming smaller and confluent towards the outer edge, and with suggestions of ridges running from the centre outwards. Rhinophores conspicuous and closely laminated well down their length, retracted into slightly raised cavities, the thickened edges of which show a very slight crenulation. Branchiae six, retractile, set round a fairly long sturdy tubular anus, enclosed in a six-lobed contractile cavity, lobes irregular in size. Oral tentacles conspicuous, flat and leaf-shape. Foot fairly long and medium size; width about one-third that of body, widest in the middle, with suggestion of blister-like pustules, truncate in front and roundly truncate behind; transverse groove at anterior end deeper than in most genera; upper lamina extending well beyond it and divided medially.

The colour of the spirit specimen is purplish-brown, with darker markings. A central dark interrupted band seems to extend from between and in front of the rhinophores, along the back to just in front of the branchial cavity. This band appears in parts to be pupilled with a lighter colour. From it other dark markings extend out in patches and rows towards the margins, and are scattered over the surface. A very dark border encircles the edge of the mantle. Tops of the rhinophores are the same purplish brown colour, the edges of their cavities dark. Branchiae and anus very light colour tipped and streaked with the body colour. Undersurface milky-white, shading to blue-white towards the margin. A wide interrupted chocolate brown band of irregular-sized blotches encircles it about half-way between the mantle edge and foot. The outer edge of the mantle is very dark purple-brown. Numerous smaller pale brown spots are scattered about the dark band, with faint bluish ones towards the margins. Foot very pale brown, with purple shading towards the outer edge. Sides of foot rich purple-brown, becoming brown at the junction of the mantle. Oral tentacles light purple-brown. Upper lamina edged with same dark colour as the body.

Odontophore: About forty rows of broad teeth; formula, 40.0.40.

Dimensions: Length of spirit specimen, 90 mm. Breadth, 60 mm.

Habitat: North-West Islet, Capricorn Group, Queensland. Type specimen (C. 57,206) in Australian Museum collection.

Described from a single specimen collected in May, 1930, by Mr. M. Ward, after whom I have named it. No colour notes were made at the time, but Mr. Ward informed me that it was a very striking and richly coloured animal when alive. The undersurface should make it easily recognisable, with its milky ground colour, band of brown blotches and dark marginal border.

The general shape, tentacular and branchial cavities and oral tentacle are similar to those of *Platydoris*, but the absence of minute granulation, an important character of this genus and the evident presence of larger pustules on the dorsal surface of the species just described, separate it from that genus. The nearest genus to which I can place it is *Asteronotus* Ehrenberg. Eliot (Proc. Zool. Soc. Lond., 1903, Pt. 2, 360) gives a good guide to be followed for the placing of doubtful genera, and this I have taken into consideration when placing, perhaps temporarily, the present species in *Asteronotus*.

Genus DENDRODORIS Ehrenberg, 1831.

Dendrodoris Ehrenberg, Symbolae physicae, 1831, not paginated, but on p. 94. Type by subsequent designation *Dendrodoris lugubris* Ehrenberg (Gray, Proc. Zool. Soc. Lond., 1847, 164).

Rhacodoris Mörch, Journ. de Conch., 3, Ser. iii., 1863, 34. Type by original designation, "*Doris laciniata* Cuvier."

Doridopsis Alder & Hancock, Trans. Zool. Soc. Lond., Vol. v., Pt. 3, 1864, 125. Type by original designation *Doridopsis gemmacea*.

Haustellodoris Pease, Amer. Journ. Conch., Vol. vi., 1871, 299; for the *Doridopsis* of Alder & Hancock.

Large animals, with soft, smooth, often gelatinous bodies, brightly coloured, and generally covered with soft warts and blister-like pustules. Rhinophores retractile, branchiae bushy and large, about 5-8 in number, wholly or partly surrounding the vent, retractile into a common cavity. Foot very broad, oral tentacles small and often represented by small folds. Mouth a small pore, through which a suctorial tube protrudes as a proboscis. There is no radula. A genus, comprised of numerous species, which usually inhabit tropical seas and are found under stones.

In 1860, Pease (Proc. Zool. Soc. Lond., 1860, 32) created the genus *Doriopsis* for a small oblong or oval depressed *Doris* characterised by the position of the branchiae, which are placed in a semi-circle on the posterior end of the dorsal surface, convex side caudad, and retractile into a similar-shaped slit. In 1864, Alder and Hancock (Trans. Zool. Soc. Lond., Vol. v., Pt. 3, 1864, 125) made the genus *Doridopsis* for a species with a large mantle, rhinophores and branchiae retractile within cavities, no oral tentacles, mouth suctorial, opening in the front of the margin of the foot, without tongue, jaws or collar, and with a retractile proboscis.

The former genus has usually been considered a synonym of *Doridopsis*, but on reading the original description of the two genera, it is seen that Pease's description refers to an entirely different genus, a fact which Mde. A. Pruvot-Fol (Bull. Mus. Nat. d'Hist. Nat., 2, Ser., Tom. 11, No. 3, March, 1930, 291) also notes. Risbec (Contribution a l'Etude des Nudibranchs Neo Caledoniens, 1928, 102) also realised that *Doriopsis* was a different genus to *Doridopsis*, and placed *Doriopsis viridis* Pease, into a new genus he created, *Guyonia*. I think that *Doriopsis* could still stand, however, for those species with the branchiae and other characters described by Pease, and that *Guyonia* becomes a synonym of it.

O'Donoghue (Trans. Roy. Canadian Instit., No. 34, Vol. xv., Pt. 2, 1926, 203) points out, however, that the genus *Dendrodoris* Ehrenberg, 1831, which Bergh (Journ. Mus. Godeffroy, Heft xiv., 1878, 21) puts aside as unsatisfactory in favour of Pease's name of 1860, is the same as *Doridopsis*, and therefore takes precedence over it. The "quite false characters" which Bergh finds in Pease's genus are the very ones which separate it from *Dendrodoris* and *Doridopsis*.

DENDRODORIS GUNNAMATTA, n.sp.

(Plate v., figs. 4-7.)

Body fairly narrow and elongate, rounded, very soft and gelatinous, mantle extended all round, edges thin and crenulated. Dorsal surface covered with large irregular-sized globular pustules, becoming smaller at the edges. In the spirit specimen these form a more or less definite pattern on the back, as follows: Along each side of the back is a row of three large tubercles, rugose on the top, and each encircled by about six much smaller ones, uniting just before the rhinophores to a single row of two similar constructions, which extends to the anterior border. Similar processes are on the border, and smaller tubercles are scattered over the whole surface. Rhinophores long and slender, upper portion diagonally laminated, retractile in cavities, with edges raised into a short sheath formed of about four tubercles. Branchiae large and bushy, five, tripinnate, set round a large tubular, independently retractile anus, which is situated slightly posteriorly between the two posterior branchiae interrupting the branchial circle. Cavity large and fleshy, formed of five elevated lobes, which seem to bear smaller tubercles. Foot very long and broad, in most of the spirit specimens extending well beyond the mantle posteriorly, and in others reaching almost to it. Margin slightly crenulated, truncate in front, rounded behind, edges thin, a very slight anterior margin groove, lamina divided by a protruding proboscis, which in some specimens does not protrude, but shows the mouth as a small pore. Lamina attached to the head; anterior to it are two small flat rounded and free flaps which serve as oral tentacles.

Colour of the spirit specimen is dirty yellowish grey. Edges of mantle yellow. A greenish grey tinge appears on the large tubercles. On the centre back, between the two rows of tubercles is a longitudinal row of three large irregular-shaped patches of dark slate colour. The shape is formed by the joining of the tubercles around them. Within most of the dark patches is a central lighter patch, with sometimes a small black spot within it. This paler patch I think is caused by the dark markings becoming faded in spirit, commencing with the centre of the coloured mark. Another row of five such markings runs along each side of the body from the front of the rhinophores to behind the branchiae, the last two posterior ones on each side uniting practically as one big blotch. The area enclosed within the slaty patches is not so tubercular as the remainder of the surface, and at first glance appears almost smooth, because the tubercles are much smaller and flatter. Upper portion of the rhinophores slaty-brown, with tips and lamination marks yellow, lower portion transparent colour. Branchiae stalks light yellow, streaked and tipped with slate-brown, giving them a dark appearance. Anus almost black. Undersurface lighter than dorsal, edges of mantle yellow, with dark patches on it, which seems to mark the bases of the surface tubercles. Foot greenish-grey, edges yellow, underneath same colour as above. Oral flaps dark, edged with yellow.

Dimensions: Length of spirit specimen, 70 mm. Breadth, 40 mm. Height, 20 mm. As the specimens have not curled at all in preservation, these measurements are practically the same as in life.

Habitat: About fifty specimens were collected at the one time on the mud flats at Gunnamatta Bay, Port Hacking, N.S. Wales, by Mr. T. Iredale and party, from the Australian Museum, in May, 1925. Mr. Iredale noted that a few were found in early May in shallow water at the edge of the sandy mud patch on the flat, and in later May when the larger number were collected they were lying exposed, and noted apparently burrowing in

the mud to keep themselves moist until the tide returned. Two were secured in November, none in March, and plenty in May. The latter month is probably near the breeding time.

Type specimen in Australian Museum collection (C. 51,204).

A colour sketch of the live animal was made at the time, but has since been mislaid. I remember it as a very velvety, rich blue, almost blue-black creature, with extremely soft, large blister-like pustules over the surface, which did not appear to fall into any definite arrangement as they did in the preserved specimen. Also, there were no decided dark blotches, except the summit of the tubercles, which seemed a little darker. In his notes, based on his visits to Gunnamatta Bay, Mr. Iredale says it has a large dark bluish body surface, with pale greenish tubercles scattered irregularly over the surface. The rhinophores are club-shaped and completely retractile, brownish-red in colour, the tips with whitish lines. Branchiae rich reddish-brown. Foot elongate, pale brown, longitudinally lined with blue, the blue sometimes extending from one line to another. The edge of the foot is yellowish, a narrow band extending round, but vanishing towards the tail. The underside of the mantle shows a crinkled edge, with dark spots appearing as eye-spots.

When alive, I had seen nothing like this species, but since being preserved its surface has so settled into a definite pattern that it somewhat resembles the sketch of *Doridopsis mammosa* Abraham (P.Z.S. Lond., 1877, 266, pl. xxix., figs. 20-21. Habitat (?): Obtained during Antarctic Expedition). The body in the latter seems more convex, the pustules smaller, although more elongated, and the rhinophore cavities raised sheath-like, whereas in the species under discussion the pustules are large, soft blister-like, the body is narrow, flatter and elongate, and the rhinophores are retractile into rounded cavities, edges of which are merely formed by a few tubercles and are not sheaths. Practically all the specimens from Gunnamatta Bay are between 60-70 mm. in length. As Abraham's species has no definite locality, and in view of the differences already noted, I consider the former a new species of *Dendrodoris*.

DENDRODORIS MELAENA, n.sp.

(Plate v., fig. 11.)

Body soft and velvety, and when extended elongate and bluntly truncate at each end. Mantle margin very wide and thrown into numerous large folds. The posterior end rather wider than the anterior end. The surface of the body is covered with soft blister-like pustules, which are only noticed when inspecting closely. Rhinophores are well separated, reaching beyond the margin of the mantle when extended, retractile, laminated. Branchiae bushy and conspicuous, seven in number, reaching beyond the side mantle edges, retractile into a rounded cavity. Foot very broad, extending well to the posterior end of the mantle. Mouth a circular pore. Oral tentacles rudimentary.

Colour of the animal when alive is a rich dark velvety black, with an occasional bluish bloom on the upper surface. Mantle margin has a narrow edging of pale yellow-brown. Rhinophores black, white tipped. Branchiae black, tipped and streaked with pale yellow-brown. Undersurface lighter than the dorsal, with a milky tinge on the foot. The edges of the foot and mantle are outlined with the same light brown tinge as above. A similar coloured area surrounds the mouth.

Dimensions: Length, 25 mm. Breadth, 12 mm.

Locality: Found under a rock at Long Reef, near Sydney, N.S. Wales, by Mr. G. P. Whitley, in October, 1930. Another specimen was found by Mr. T. Iredale at Queenscliff, not far from Long Reef, some years before, and which I figured at the time. It was placed in the Museum aquarium, but unfortunately disappeared. It was a larger specimen, 37 mm. long and 22 mm. broad, but was otherwise identical with the Long Reef one.

DENDRODORIS MORULIFER, n.sp.

(Plate v., figs. 1 and 2.)

Body very soft and large, roundly oblong, the mantle well extended, marginal edges thin. Dorsal surface covered with numerous very large protuberances, the surface of which is composed of smaller tubercles, making the protuberances resemble somewhat a mulberry in the spirit specimen. One of these protuberances is situated between and anterior to the rhinophores and almost on the mantle margin. Two more are in a row on the central median line, commencing posterior to the rhinophores. Half-way down this line is a suggestion of another, and posterior to the branchiae a large one overhangs the mantle margin, making five in all along the central dorsal line. About five similar large protuberances form a line on either side of the central row, each one being situated between those on the middle row. A well marked one is on each side of the central anterior gill, and one on either side of the posterior gills. Along each side of the dorsal surface fairly large blister-like pustules surround the larger protuberances and fill up the gaps dividing them. The thin edges of the mantle are overhung by these pustules, which are extremely numerous and crowded round the margin and immediately posterior to, and anterior to, the rhinophores. There is only a suggestion of these pustules on the dorsal central surface. In the spirit specimens, rows of lines encircle the base of the protuberances, but it is difficult to say whether in life these are colour markings, ridges, or small faint tubercles. The rhinophores are retractile, large and conspicuous, laminated, and with a tendency to bend backwards. Their openings are wide and the edges are outlined with small pustules. The branchial plume is large and bushy and is slightly withdrawn into an ample cavity, the margin of which is pustulose, a little elevated and faintly divided into five lobes. The branchiae are divided well down to their base, tri-pinnate, five in number, with a free space between the two posterior ones. The retractile anus is situated in its own cavity, slightly posteriorly and practically between these two. The foot is long and broad, with a tendency to pustulation, rounded at the anterior end and narrower towards the posterior end. The margins are thin and slightly crenulated. The head is small, with no sign of an anterior marginal groove. Oral tentacles are small, inconspicuous flaps on the side of the head. Mouth a minute pore.

The colour of the spirit specimen is dark slaty-green, with the large protuberances and some of the pustules very light brown. Many of the pustules round the mantle seem light colour, with dark green centres. The rhinophores are light brown. Central dorsal surface very dark. Branchiae very dark greenish colour, lighter tipped. The undersurface should make identification of this species simple. It is greenish-slate colour, becoming pale towards the centre, and has numerous large rounded and oval spots scattered over the surface. These, in the spirit specimen, are milk white, with a suggestion of a thin dark ring encircling each. They may have been yellow in life and resemble in their shape and position on the mantle those on the undersurface of *Doris tuberculata* Q. & G. (Voy. de l'Astrolabe,

Zool., 2, p. 248, pl. 16, figs. 1-2) from New Guinea. A narrow darker band of colour is on the mantle round the foot. The foot is a slightly lighter shade than the ground colour of the undersurface.

Dimensions: Length in spirit, $5\frac{1}{2}$ inches. Breadth, 4 inches.

Locality: A single specimen brought back from North-West Islet in January, 1931, by Messrs. A. A. Livingstone and W. Boardman, who were unable to give me any idea of its colour in life as it was collected by another member of the expedition on the islet at that time, and was placed in the jar set aside for the nudibranchs, without their knowledge. Type specimen (C. 57,212) in Australian Museum collection.

DENDRODORIS RAINFORDI, n.sp.

(Plate iv., figs. 14 and 15.)

Animal large, plump, softly rounded. Dorsal surface covered with large irregular-sized blister-like tubercles, bearing smaller ones on their surface, and becoming smaller and more congested towards their edges. Margin crenulated. Rhinophores pointed at tip, one retracted in specimen, and the other not, pointing backwards, laminated; cavities raised and rounded. Branchial plume large, conspicuous and bushy, seven in number, tripinnate, not fully retracted in specimen, set in a slightly raised cavity, the edge of which shows an inclination to form faint lobes. Anus, independently retracted, and set well back against the wall of the cavity, between the two posterior branchiae. Foot long and very broad, roundly truncate in front and behind, margins crenulated. No pronounced groove at the anterior end; upper lamina divided, forming ample flaps. Oral tentacles inconspicuous, small folds which do not project freely. Mouth small and pore-like.

The whole undersurface, including the foot, is covered with the same blister-like tubercles as on the upper surface.

Colour of the spirit specimen is light yellowish-brown, with large round irregular-sized purplish-brown rings scattered over the surface. These rings contain within them numerous small spots and lines forming more or less designs, and giving a hieroglyphic appearance to them. There are six large ones on the central dorsal surface, two about three-quarters of an inch in diameter are situated immediately in front of the branchiae, two a little larger in the centre, and two more before the rhinophores. A much smaller one is between the rhinophores and a similar-sized one is anterior to them. A row of fairly small ones encircles the body where the mantle commences, from the rhinophores to the branchial plume. Immediately posterior to the branchiae is a large purplish-brown blotch. Smaller ones of similar colour appear at intervals amongst the rings along the mantle. The margin of the mantle has a band of large and small rings, about thirteen in number, encircling it.

Undersurface paler than dorsal, the pattern on the mantle margin the same as above, as though it was showing through. Foot dark purplish-brown in centre, shading to paler colour towards the edge, with a few dark rings on it, which, as in the case of the mantle edge, appear in the same position on the undersurface. Branchiae light coloured, heavily streaked and tipped with dark brown, giving them an almost purplish appearance. Rhinophores purplish-black, white tipped.

This very handsome and conspicuous animal which was found floating on the surface of the water by Mr. E. Rainford and presented to the Australian Museum by him would be easily recognised on account of its

large dimensions, large branchial plume, and the extraordinary markings on its surface.

As only one specimen was found by Mr. Rainford and is still the only one in the Museum collection, I do not think it is advisable to dissect it. The specimen has curled up considerably in preservative, giving to the margins of the mantle and foot an exaggerated crenulated appearance, which would not exist to such a degree in life.

Dimensions: Length in spirit, $6\frac{1}{2}$ inches. Breadth, 4 inches.

Habitat: Port Denison, Queensland. Type specimen (C. 49,974) in Australian Museum collection.

The markings on the surface of this species resemble somewhat those seen in the figure of *Kentrodoris annuligera* Bergh (Bergh, Reis. im. Archipel der Philippines von Semper, 1892, Heft. viii., Taf. lxxxv., fig. 8 and Heft. viii., Taf. xli., fig. 1, 1875), but their external characters alone dissociate them.

Genus POLYCERA Cuvier, 1816.

Polycera Cuvier, Regne Animal, Vol. ii., 389, "1817," i.e., December, 1816.

Type by subsequent designation, Gray, Proc. Zool. Soc. (Lond.), 1847, 165; *Doris quadrilineata* Muller.

Themisto Oken, Lehrb. Naturg. Th., iii., Zool., Pt. 1, x., 278, 1815. Type, *Doris quadrilineata* Muller. Not *Themisto* Oken, Goetting, gelehrte Anz., 1807, 1168.

Cufaea Leach, Synops. Moll. Great Britain, 21, December, 1852. Type by monotypy, *Doris flava* Montagu.

Conspicuous and active animals, usually with vividly contrasting colours on the body. Limaciform shape, with no definite mantle, but the body is marked by a ridge at the sides, which continues round the head. The front part of this ridge forms a veil and bears elongate processes or tubercles. Branchiae generally simple, but may be bi- or tripinnate, with usually one or more appendages on either side of them. The branchiae and rhinophores are retractile. The body swells a little in the centre where the heart is. Mouth large, foot linear. Their range extends throughout the European seas, but previous to the writing of this paper the genus does appear to have been recorded from Australian waters.

They are found among sea-weeds in rock-pools and on floating timber and wharf piles.

POLYCERA CONSPICUA, n.sp.

(Plate iv., figs. 12 and 13; plate v., fig. 15.)

Animal slender, elongate, a little swollen in the middle and tapering to a long pointed tail behind, smooth, transparent, white in colour, the internal organs showing through produce a greyish-pink appearance in parts. Rhinophores large and conspicuous, subclavate, set fairly far apart, broad at base, bending slightly backward, upper part with about twenty-eight laminations, grooved down the centre, black, with base and tips smooth and white, non-retractile, and about the same length as the frontal appendages. Frontal veil well expanded and ornamented with six bright yellow elongated pointed appendages of more or less equal length, situated three on either side, the posterior pair in a line with the rhinophores. Branchial plume large, erect and conspicuous, situated about midway along the animal and just behind a small swelling containing the heart. When fully expanded, it stretches well beyond the side body margins. It consists of eleven simply-pinnate tapering branchiae, the two posterior ones very small, and the central anterior one the largest. Colour black,

with stems whitish and tips yellow. On each side of the branchial plume is a single large bright yellow tentacle of the same appearance, but about twice the size as the frontal appendages, and with base whitish. Foot linear, grooved down centre, lobed in front, sides slightly undulated, white. Mouth large.

A broad black line extends along centre of dorsal surface, from between the two anterior frontal appendages to just behind the branchial plume. Another similar black line extends along each side of the body underneath the last pair of frontal appendages to about midway between tip of tail and branchiae. The black line on the right side is interrupted by the presence of the genital opening. A narrow bright yellow line runs along dorsal surface of the tail, from the tip almost to the termination of the central black line. A line of similar length and colour extends along the upper outer margin of the tail.

Dimensions: Length, 2 inches. Breadth, $\frac{3}{4}$ inch. Type, Australian Museum collection. Registered No. C. 57,211.

Habitat: Sydney Harbour, N.S. Wales. About eight specimens in all have been brought to the Museum since 1927. Previous to that year there had been no specimens in the collection. Some of them were found by members of the crew of the Harbour Trust launches, when examining wharf-piles for borers, and were attached either to the piles or brought up on sea-weed, usually between the months of September and May. One specimen was dredged off Watson's Bay, Port Jackson, by Captain Comtesse, of the dredge "Triton," in September.

This conspicuous little animal is easily recognised by its beautifully marked body and large erect black waving branchiae, broad black bands along the sides and centre, contrasting bright yellow frontal appendages and body tentacles. It is far more active than the Dorids, and uses its tail freely for attaching itself to sea-weed or any object it comes in contact with, and with it as an axis is able to revolve into many positions. One specimen had the two body tentacles divided at their bases, but as all the other characters were the same I think this was only an aberration.

Resembles somewhat *Polycera capensis* Quoy & Gaimard (Voy. "Uranie," Zool., 1824, 417, pl. 66, fig. 4), from the Cape of Good Hope, but this species has the frontal tentacles much smaller, and the black lines on the body do not extend to such length as those in the Sydney Harbour species, and are not so conspicuous.

It also resembles the sketch of *Polycera nigrocrocea* Barnard, from S. Africa (Ann. S. Africa. Mus., Vol. xxv., 1927, pl. xix., figs. 7-8), but several differences separate them. The latter species seems to me to be very close to *P. capensis* Q. & G., and, considering the localities of the two, it would be nearer that species than the Sydney Harbour one.

Genus NOTODORIS Bergh, 1875.

Notodoris Bergh, Journ. de Mus. Godeffroy, Heft. viii., 1875, 64-67, 196-197, Taf. ix., figs. 32-45, Taf. i., 1-8. Eliot, Fauna and Geography of the Maldive and Laccadive Archipelagoes, Vol. ii., Pt. 1.

Animal limaciform in shape, with no clear distinction between the back and sides. Body surface is hard, rough and rugose. Frontal veil ample. The branchiae are small and are protected by a large valve, which is sometimes elaborately divided and subdivided. The rhinophores are smooth and are sometimes also protected by valves. Very few species are known, and they are all yellow in colour, sometimes with darker spots or markings on the dorsal surface. It has been noticed in some cases that

they resemble in colour and general appearance the vivid yellow sponge on which they are sometimes found. Professor W. J. Dakin found that what seemed at first sight to be small pieces of brilliant lemon-yellow sponge falling off a straggling mass of lemon-yellow sponge at the Abrolhos Is. were really nudibranchs of the same vivid colour, resembling the sponge also in general appearance. These were the species of Notodorids, discussed by O'Donoghue, and mentioned below. On the other hand, the species found commonly at North-West Islet, Capricorn Group, crawled about amongst rock crevices, where it showed out most vividly against the contrasting background, and made no attempt to conceal itself. They are found in tropical seas, and so far very little is known of their habits.

The genus was created by Bergh for a single species, *N. citrina*, from Raratonga. Eliot obtained another at Zanzibar (*N. minor*) and with his *N. gardineri* from Hulule, Maldive Islands, the species described below from North-West Islet, Capricorn Group, brings the known species to four. O'Donoghue (Journ. Linn. Soc. Lond. Zool., 1924, Vol. xxxv., No. 237, 565, pl. 28, figs. 13-19; pl. 30, figs. 62-64) describes a species from the Abrolhos Is., Western Australia, which he attributes to *N. gardineri*. Three specimens of this species were obtained, and he therefore records the genus for the first time from Australian waters. The Barrier Reef species is the first record of the genus from the east coast of Australia.

NOTODORIS MEGASTIGMA, n.sp.

(Plate iv., figs. 9-11.)

Body limaciform, lengthening to a tail which forms almost half the length of the entire animal. Hard, rough and rugose, with a large, rounded frontal veil. The body is covered with irregular-sized thick heavy protuberances, somewhat flattened on their apex, and the larger ones rugose on their upper portions. They are arranged in a row round the frontal veil along the upper sides of the body as far as the branchial lobes, about twelve in number, and diminishing in size around the veil. Two similar rows run down the central dorsal area, from anterior to and between the rhinophores to the branchial lobes. A series, somewhat smaller in size, extends from the area surrounding the anus down the centre of the tail to its tip, and along the sides of the tail and body are several rows of smaller protuberances. The area round the anus is well covered with very small ones.

The rhinophores in the specimens are completely retracted, their openings being protected by a valve. The numerous, rather small non-retracted gills are well protected by a large conspicuous branchial lobe, composed of three parts, each of which is clearly divided and furnished with small irregular-shaped leaf-like processes. In the spirit specimens, the gills protrude slightly beyond the branchial lobe in parts. The flat foot occupies the whole undersurface. Oral tentacles, flat and broad, are hidden by the overhanging veil.

The colour is vivid yellow, with large black spots and patches scattered over the dorsal surface, and smaller and more minute ones intermingling. A very large patch extends across the central portion immediately behind the branchial lobes, another one placed on the side of the central dorsal protuberances, midway between the branchial lobe and the frontal veil, and a smaller one anterior to the right rhinophore valve. A spot of similar size to this is posterior to the anus, and a very large elongated patch is on either side of the central tail ridge, with a few smaller spots posterior to it. There are no colour markings on the undersurface.

In another specimen there is a black spot anterior to each rhinophore valve, with two more posterior to them, and the large patch on each side of the tail ridge is divided into spots instead of being entire. The spirit specimens have faded to a light greenish-grey, with the branchiae the same colour, and the black patches commencing to fade towards the centres.

Odontophore, dark colour, about 45 rows of long curved teeth, large at sides.

Dimensions: Length of spirit specimen, 65 mm. Breadth, 20 mm.

Habitat: Two specimens brought back by Messrs. A. A. Livingstone and W. Boardman from North-West Islet, Capricorn Group, Queensland, in January, 1931, who assert that it was the commonest sea-slug seen on the island at that particular time. It was found crawling among coral crevices, making no attempt to conceal itself, and its vivid colour showed out most strikingly. Specimens were also collected in 1930 at North-West Islet by Mr. Melbourne Ward. Type (C. 57,209) in Australian Museum collection.

The species somewhat resembles *N. gardineri* Eliot (Fauna and Geography of the Maldive and Laccadive Archipelagoes, Vol. ii., Pt. 1, 548, pl. xxxii., figs. 7-8), but in the latter the spots are very much smaller and fewer, and the ridges mentioned by Eliot on the dorsal surface of his species are replaced by large protuberances in the North-West Islet species. The three specimens described by O'Donoghue from the Abrolhos Is. as *N. gardineri* Eliot, according to the colour notes made by Professor Dakin,

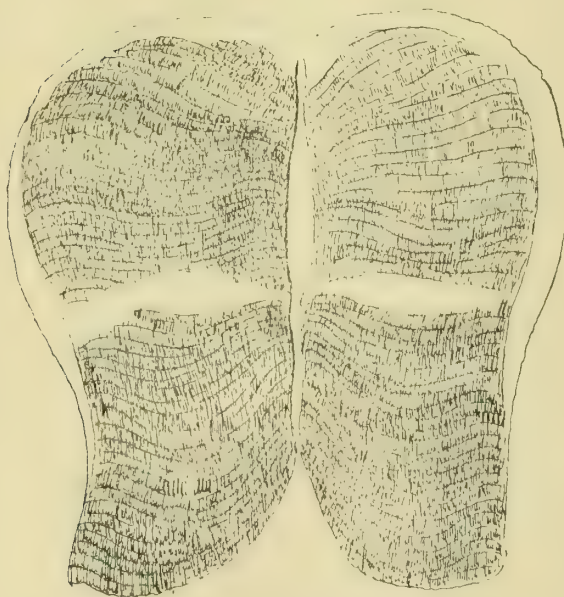


Fig. 1. Radula of *Asteronotus brassica*.



Fig. 2. Teeth of *Asteronotus brassica* (greatly enlarged).

have no black markings, or spots, which are present in the Queensland species.

Both the specimens from the Abrolhos Is. and Eliot's specimen are much smaller in size than the former.

EXPLANATION OF PLATES.

Plate iv.

- Figs. 1, 2. *Discodoris whitleyi*.
 „ 3, 4. *Platydoris iredalei*.
 „ 5, 6. *Platydoris capricornensis*.
 „ 7, 8. *Dictydoris aurantiomaculata*.
 „ 9, 10, 11. *Notodoris megastigma*.
 „ 12, 13. *Polycera conspicua*.
 „ 14, 15. *Dendrodoris rainfordi*.
 „ 16, 17. *Asteronotus wardianus*.

Plate v.

- Figs. 1, 2. *Dendrodoris morulifer*.
 „ 3. *Platydoris iredalei*. Internal structure.
 b = buccal mass, r = rhinophore, n = nerve centre, o = generative organs, s = stomach, i = intestine, l = liver, k = pericardium, v = ventricle, y = auricle, g = gills, a = anus.
 „ 4, 5. *Dendrodoris gunnamatta*.
 „ 6. *Dendrodoris gunnamatta*. Internal structure.
 b = buccal mass, r = rhinophores, n = nerve centre, o = generative organs, s = stomach, i = intestine, l = liver, k = pericardium, v = ventricle, y = auricle, g = gills, a = anus.
 Figs. 7. Proboscis of *Dendrodoris gunnamatta*.
 „ 8. Internal structure of *Dictydoris aurantiomaculata*.
 b = buccal mass, r = rhinophores, n = nerve centre, o = generative organs, s = stomach, i = intestine, l = liver, k = pericardium, a = anus, g = gills.
 „ 9. Gills of ditto.
 „ 10. Teeth of ditto.
 „ 11. *Dendrodoris melaena*.
 „ 12, 13. *Asteronotus brassica*.
 „ 14. *Asteronotus brassica*. Internal structure.
 b = buccal mass, r = rhinophores, n = nerve centre, o = generative organs, s = stomach, i = intestine, l = liver, k = pericardium, g = gills.
 „ 15. Internal structure of *Polycera conspicua*.
 b = buccal mass, r = rhinophore, os = oesophagus, o = generative organs, s = stomach, i = intestine, l = liver, g = gills, a = anus.

A RE-EXAMINATION OF *GYMNOBELIDEUS LEADBEATERI* MCCOY.

By C. W. BRAZENOR, National Museum of Victoria.

(Plate vi.)

The two original animals (N.M.V., Nos. R.12,366-7) upon which Sir Frederick McCoy established the genus *Gymnobelideus* were collected in 1867 and described by him in the same year. He assigned to them the specific name of *leadbeateri*, after J. Leadbeater, the taxidermist of the National Museum of Victoria.

In 1900 the late Sir Baldwin Spencer purchased a mounted specimen (N.M.V., No. 58,439) from a Melbourne dealer and presented it to the institution. A fourth specimen (N.M.V., No. R.4,123) was presented by Mr. A. G. Wilson in 1909. A further mounted specimen (N.M.V., No. R.6,042) was recognised by Sir Baldwin Spencer in the office of Mr. F. V. Mason in whose possession it had been for many years, and who presented it to the National Museum. These five skins are the only known examples of the genus.

McCoy in his original description notes that "specimens of both sexes are preserved" (in the National Museum). Re-examination of his material, however, indicates that both animals are males. They were originally mounted for exhibition, in which state they remained until 1899, when they were re-made into cabinet skins. The type skull, which is badly damaged, was at that time removed from the skin and placed in the osteological collection. A portion of the occipital region is cut away, though a little of the anterior border of the foramen magnum remains. The premaxillae, the maxillae, and the nasal bones have been damaged by the passage of a wire down the nasal cavity. The posterior end of the palate is broken, but enough remains to enable the length of the posterior palatal vacuities to be determined.

McCoy's figure of the skull, being a lithograph, is reversed.

In view of the fact that the National Museum is in possession of the only specimens of this interesting and possibly extinct animal, and that since McCoy described it additional material has come to hand, it has been thought desirable to give a slightly revised and somewhat fuller description of it.

GYMNOBELIDEUS McCoy.

General appearance as in *Petaurus* but without the lateral flying membrane. Digital formula of manus 4—3—5—2—1. The apical pads of the fingers spatulate, striated, and fringed with hair; in length equal to, or longer than the nails, which are much less developed than in *Petaurus*. Basal third of tail covered laterally and above with fur of body. Under-side lightly clothed with short stiff hairs. Apical two-thirds, with hair gradually increasing in length towards the tips, where it becomes uniformly bushy. Dental formula I., $\frac{2}{1}$. C, $\frac{1}{1}$. P, $\frac{2}{1}$. M $\frac{2}{1} \times 2 = 40$

Gymnobelideus leadbeateri McCoy, Ann. Mag. Nat. Hist. (3), xx., 1867, 287, and Prod. Zool. Vict. Decade, x., 1883; Thomas, Cat. Mars. and Mon. Brit. Mus., 1888, 149; Lydekker, Mars. and Mon., 1894, 111.

General form very like *Petaurus*, but without flying membrane. Fur soft but shorter, and not so silky as in that animal. Hair of dorsal surface measures 11 mm. General colour brownish grey with a dark brown

dorsal stripe from the head to the sacrum. Muzzle short and pointed. Rhinarium naked, finely granular, and cleft. Face lighter than body with a dark patch above and another below the ear. The area around the eye is somewhat darkened. The facial vibrissae are well developed, the mystacial measuring 35 mm. All are dark brown in colour. Ears large and oval in outline, the outer surface almost naked towards the tip. Inner surface entirely naked, and with a well developed metatragus. Dorsal surface of the body brownish grey with a dark brown dorsal stripe which broadens slightly behind the forelegs, contracting again in the lumbar region. Individual hairs are grey for three-fourths of their length, then fawn grey tipped with brown; the very few long hairs are entirely brown. Chin and throat dull buff. Chest, inner surface of limbs, and ventral surface of the body light, yellowish grey; hairs basally grey with light tips. The line of demarcation between the ventral and dorsal surface is sharp. Tail tapering, about as long as the head and body. The basal third is clothed laterally and above with the fur of the body, the hair of the remaining two-thirds gradually increasing in length towards the tip. Under-side of tail sharply marked for about basal half with short, stiff hairs, which then become less defined towards the tip where it is uniformly clothed. Manus lighter than body. Palm granular, with five well developed, coarsely striated pads. Apical pads of digits spatulate, striated, and fringed; as long as, or longer than, nails, which are not well developed. Digital formula 4-3-5-2-1. Pes light, brownish grey. Sole naked and granular, with five pads. First digit well developed, opposed and clawless. The syndactylous digits bear stronger claws, and the terminal pads are not enlarged; fourth and fifth digits with spatulate, striated, and fringed pads, the nails showing less development. Digital formula 4-5-2.3-1.

Skull: In general form very like *Petaurus*, but more delicately built and with a narrower muzzle. The great inflation of the posterior squamosal portion of the zygomata, which is marked in that genus, is greatly minimised in *Gymnobelideus*. The posterior portion of the palate is slightly rounded, the molars being in slightly curved rows, and the margin extends well behind the last molar tooth. The posterior palatal vacuities are large and reach from the mid point of m1 to the posterior border of m3. Teeth as in *Petaurus*, but smaller.

Dimensions of Type Skin: Head and body, 175 mm.; tail, 171 mm.; hind foot, 26 mm.; ear, 19 mm.

Dimensions of Skull: Basal length, 32 mm.; greatest breadth, 24 mm.; Nasals, length 14 mm.; nasals, greatest breadth 7 mm.; nasals, least breadth 3 mm.; intertemporal breadth, 7.5 mm.; palate, length 18 mm.; palate, breadth outside m2 9.5 mm.; palate, breadth inside m2 6.5 mm.; palatal foramina, 4 mm.; basi-cranial axis, 13.5 mm.; basi-facial axis, 18.5 mm.; facial index, 137.

Teeth: Height of canine, 1.7 mm.; length of p4, 1.7 mm.; length of molars 1-3; 5 mm.; length of lower i1, 6 mm.

Habitat: Bass River, Western Port, Victoria.

The length "from snout to base of tail" given by McCoy as 5 inches 4 lines (135 mm.) is obviously incorrect. Though the present measurements are taken from a cabinet skin, it is not possible that it could have been stretched to the extent of 40 mm. If his "length of head" (1 inch 8 lines) be added, the total is approximately the correct length.

Measurements of the remaining skins are added for comparison. The mounted specimens are measured with a tape following the curves. The cabinet skins are measured in a straight line.

	R. 12,366	58,439	R. 6,402	R. 4,123
	Cab. skin.	Mtd. spmn.	Mtd. spmn.	Cab. skin.
Head and body ..	169	200	195	174
Tail	170	185	203	168
Hind foot	27	27.5	27	28
Ear	21	20.5	21.5	20

Colour: The range of colour in this series of skins is wide. The second specimen of McCoy is lighter throughout than the type, being fawn grey in general colour. The dorsal stripe is not so dusky; it commences on the muzzle and is almost lost on the nape of the neck, reappearing on the shoulders and extending to the base of the tail. The ventral surface is also lighter, though of the same general colour. The tail is uniformly coloured like the body.

The specimen presented by Sir Baldwin Spencer agrees in the colour of the body with the type, but the face is darker rather than lighter. The dusky patch under the ear continues across the cheeks and under the chin. The apical third of the tail is slightly darker, and the ventral surface of the body is duller and greyer in tone.

Mr. Wilson's specimen is a grizzled grey in general colour, most of the warm brown being absent. This also applies to the ventral surface and the lighter face, which are not as yellow as in the type. The tail of this specimen is slightly longer in proportion and the apical half is black.

The remaining animal is grey, and very similar in colour to *Petaurus breviceps* Waterhouse. The dorsal stripe is black and sharply defined. The ventral surface is greyish white, very slightly tinged with yellow. The long hairs on the tail are slightly darkened at the tips, otherwise the tail is of the same colour as the body. The hairs of the pouch are bright red. This is the only certain female of the series, though the other grey specimen may also be of that sex.

Distribution: McCoy's specimens were collected in the scrub country on the bank of the Bass River, South Gippsland, Victoria, and Professor Spencer's animal is also reputed to come from that locality. The remaining two specimens, however, prove that the distribution was very much wider than this restricted area.

Mr. Mason has been kind enough to supply the following information regarding the specimen collected by him:—

It was taken many years ago . . . "from the edge of the Koo-Wee-Rup Swamp (long before the swamp was drained), about three miles due south from Tynong Railway Station. We were felling a tree, and as it fell the little animal came from a hollow branch. I had never seen one before, though we had lived for many years on the place."

No details are known regarding Mr. Wilson's specimen, except that it was taken at Mount Wills in East Gippsland, some 160 miles from the Bass River habitat.

General Conclusions.

The colour of *Gymnobelideus* appears to vary considerably, but the amount of material available is not sufficient to justify any very definite conclusions. McCoy's original animals were collected in winter (July), but there is no record as to the season in which any of the remainder were taken.

The three brownish animals are males, and the grey specimen a female. It is impossible to sex the specimen intermediate in colour, there being no trace of either scrotum or pouch.

Timber and dense scrub are common to all the recorded localities, but the higher altitude of the Mount Wills country would necessarily involve a colder climate. Professor Spencer's animal, which, though it has minor differences, agrees in general colour with the type, is reported to come from the Bass River. This needs verification, which cannot now be procured. The Mount Wills specimen is the greyest in the series, and that from Koo-Wee-Rup, collected only a few miles from the Bass River habitat, is intermediate in general colour, but differs from both in having a black tail.

There is much virgin scrubland in Gippsland in which the small creature could survive. It is nocturnal in habits, and its general resemblance to *Petaurus breviceps* is close enough to make its recognition by evening light very difficult. When these facts are considered, the possibility of its survival is greater than might at first be realised, and it is probable that a systematic search would re-establish this small creature among the living mammals of Victoria.

Explanation of Plate vi.

General form of *Gymnobelideus leadbeateri* McCoy, No. 58,439, Coll. Nat. Mus. Vict., figs. 1 and 2. Basal and lateral view of skull. x 2. No. R. 12,367. Coll. Nat. Mus. Vict., type.

NOTES FROM TARONGA ZOOLOGICAL PARK.

By A. S. LE SOUEF, C.M.Z.S.

Call of the Cassowary.—The most usual call of the Cassowary consists of three short grunts, which are uttered when running. This has been heard from the Ceram and the Australian birds. The New Britain Cassowary (*C. mitratus*) has often been heard to make a peculiar high pitched rattling sound, something like that made by a stick being rapidly rattled in a tin can. When this noise is made the neck is distended and the bird bows the head.

"Angler Fishing."—The striped Angler Fish (*Antennarius striatus*) in the Taronga Park aquarium has often been seen to try and attract fish with its special frontal appendage. This is a small rod about an inch in length, on the end of which is a reddish protuberance. This is extended forwards and moved about rapidly in the water for a few seconds, and then withdrawn and hidden in a groove on top of the head. If an unwary fish comes too near it is at once snapped up. The Angler Fish itself is perfectly camouflaged, and looks exactly like a rock covered with short seaweed growth.

The Death Adder.—Mr. John Creevy, who is an observant bushman, states that he has seen the Death Adder (*Acanthophis antarcticus*) lie in a curled position with the head about an inch from the tail, and move the small spine on the end of the tail, so as to resemble a grub or caterpillar, and thus attract birds to their doom. The snake itself is, of course, perfectly camouflaged, as it exactly resembles its surroundings. One could hardly imagine the lethargic adder capturing its food in any other way, for, although remarkably quick in movement within its own radius, it is otherwise very slow and inactive.

Movements of the Penguin.—The Fairy Penguin is remarkably fast under water, and has wonderful eyesight. One placed in the large shark pool at Taronga Park showed the greatest agility, and had no difficulty in capturing fish, which it was able to detect from some distance. It was also interesting to note the number of fish that the bird could consume at one time. We saw it take seven four inch hardiheads in a few minutes, and it was then still looking for more.

I. FACTS AND FANCIES PERTAINING TO PLATYPUS.

By HARRY BURRELL, C.M.Z.S., F.R.Z.S.

In this journal, Vol. 6, 301, I mentioned November 13, as being the latest date upon which I have taken eggs from the nests of *Ornithorhynchus*. That statement was incorrect; it should have read November 6. Having to rectify my error here, I will take the opportunity to follow on with further data pertaining to that particular subject. I do this in order to confirm the fact that the November layer was not a solitary example of very late laying, and also to discuss again the matter of platypus, being able, under certain conditions, to lay twice in the one year.

In the first place, I may say that I found the breeding season of 1930 similar to that experienced by me in 1928. On each occasion early floods were frequent and sufficiently severe to interfere considerably with the early impregnated brooding platypus of the Manilla rivers. Indeed, so much had the elements interfered with their requirements that I was unable to secure even one hatched-out young platypus, of any age, and this notwithstanding the fact that I endeavoured to do so, under perfect conditions, from October 6 to November 7. During that period my assistants had opened up a few newly excavated burrows that had been put in early in the season. Some of these were of fair length, but without terminal cavities or pug pits, and the condition in which they were found indicated a disturbance that floods would bring about.

It was evident that a deliberate attempt had certainly been made by female platypus to burrow for brooding purposes. In one bank, two complete brooding burrows were discovered; one was quite ready for the reception of nesting material, while the other was already furnished with a complete nest. But both of these burrows were unoccupied and evidently had been deserted because of abnormal adverse conditions occurring at that time. The nest, though new, was dry, and appeared, according to my judgment, to have been constructed early in the season. Perhaps I should explain here that brooding platypus caught in such a plight may endure a storm flood that will recede as fast as it rises—say, for a day or two, or even longer—but when a repetition of flushes occurs, within a week, the layer is necessarily a subject of a double event in one season, because the creature imprisoned is usually compelled to crawl out through the water and desert its quarters, even at the risk of slipping its eggs to rot anywhere. This, not only because of the discomfort to herself at the time, but because the hosts (river weeds) of her food supply will be swept away by the surging waters also.

Probably brooding platypus are "wise to" that fact, just as is the scrub turkey to the weather conditions it requires before building its mound. Be that as it may, consider these facts: On November 7, when the prospect of my finding even advanced nestling platypus (because of the lateness of season) appeared hopeless, I had unearthed for me a brooder that had not yet laid. Probably she would not have done so that day, but I will not say any longer, because I find that when a brooder has pugged herself securely in the nesting cavity, as this one had done, she will soon deposit her eggs. Now, providing that she would have laid that day, if we allow two weeks for the incubation of the eggs, and another six weeks for the young to develop well into pelage—an age at which I have taken no less than six specimens from three separate nests in one normal season, and

Note:—No attempt has been made to edit this paper, which is presented in Mr. Burrell's own original and graphic language.—Ed.

frequently on other occasions also. The young of the female referred to, although hatched in November, would not have permanently deserted the nest until about the second week in January of the following year. Even if the eggs were laid in the middle of December, the young would be hatched out at the end of that month.

I mention this principally to show the duration of time an early-laying platypus, in normal times, would have at her disposal for a second laying in one year. If she laid early in August she could desert her brood at the end of September, and so be at freedom during October to become impregnated and lay again during the month of November. On the other hand, if through floods she should be forced to slip her eggs in August, six or seven weeks would be at her disposal for copulation purposes to lay again on November 7. This, then, may afford some idea as to the probabilities of an occasional platypus, at least, being able to lay twice in the one season. That does not imply, of course, that an exceptionally late probabilities also exist that she had not met a male during the early rutting session. Until further data on this perplexing problem can be obtained, I will leave it at that, and touch upon a subject entirely dissimilar.

From the time a young platypus commences to nuzzle for its mother's milk, up to the age of approximately four weeks, it nuzzles with its "milk-spur," a caruncle that is situated on the dorsal surface of the muzzle. But, as the "milk-lips" change in character—that is to say, as the top lip splays and becomes over-shot to dwarf the lower lip—the method then of inducing the milk to flow is very different. Of course, the change-over is very gradual, and with this parting of the lips gradually, also, recedes the caruncle (situated at a point between the divided extremities of the top mandible and the nostrils) probably to sensitise, or at least strengthen, the film that, when necessary, serves to stiffen the lip (see *The Platypus*, p. 120). The above theoretical statement may appear to be a long-range shot at the target; nevertheless, I consider it to be a feasible conjecture, especially if we take into consideration the following points: Firstly, who can say for certain that the caruncle, so conspicuously developed in the foetus of *Ornithorhynchus*, is intended for breaking through the egg capsule? I certainly cannot, and, further, I fancy that the foetus could break through just as well with the fore-claws, aided by a caruncleless snout. Secondly, in a like manner the creature may possibly induce milk to flow minus a caruncle. Now, providing there is no necessity for the caruncle during those functions, and apart from my previous theories, nothing definite has been stated by other investigators on this subject. What other purpose, then, does it serve? It is so perfect and constant a character in all specimens that I have collected that I cannot imagine it to be some rudimentary feature pertaining to past ages. The caruncle is probably the seat of a special nerve centre specifically intended to control the sixth sense that I have repeatedly referred to as appearing so uncanny a trait in *Ornithorhynchus*. It is situated close to the brain, and is possibly connected thereto. Surely this noduled "something" was never intended to dwindle away to nothing, as it appears to do, without serving some function.

The sixth sense that I suspect the platypus to possess is without doubt essential to the welfare of the creature in the procuring of its wary prey (shrimps) during its adult career. Therefore, is it not logical to suppose that it would appear to be even more essential to a helpless and blind embryo while "carunculating" or rooting about for nourishment in the vicinity of teatless milk glands?

From theory, I return to fact. When the lips of a nestling platypus have taken on the over-shot shape already mentioned, and the creature is yet depending upon mother's milk for its sole sustenance, the method of the sucker then is to cling firmly with its fore-claws to the abdominal fur of its mother, and repeatedly to score the while the milk-gland area with the undersurface of the upper lip (the action is similar to a teller drawing coins from a counter with finger-tips). Actions such as these are certainly the reverse of those practised prior to this stage. Judging by the vigorous way a motherless nestling displays its method of milking, I am convinced that the abdomen of the mother must receive severe treatment when encountered by a hungry nestling, to say nothing of how she would fare were she blessed with advanced triplets that are tumbling over one another for milk. I fear the treatment would be far more severe than that meted out to nipped udders by the offspring of cloven-hoofed mammals under similar circumstances. On such occasions, though, I fancy that the mother platypus would deal with her "brood" one at a time. This, from my knowledge of her intelligence, she is quite capable of doing, although I, armed with a "teatless-dummy" and much patience, completely failed to accomplish the feat myself. This was not because of the timidity of my charge; nor was it due to lack of perseverance on my part, but probably it was due to my not chastising them, as their mammy certainly would have done had occasion demanded it. How could I bite a nestling platypus?

The milk-glands of a platypus, when fully developed, reach from the arm-pits to the groins, and from these points to almost any portion of the precise undersurface of her anatomy milk may be drawn to the perforated outlets (situated on either side of her abdomen) through which the milk oozes. Peculiar as it may appear, the full range of the glands corresponds admirably with the area of light-coloured fur found on the lower surface of the trunk of a platypus. I give this description so as to instil into students the enormous area a young platypus has to grapple with (one way and another) in order to completely drain the glands through their central openings. I fancy, however, that the method adopted by a nestling platypus to drain the paired glands of its mother is not so far removed from that of other mammals as may be supposed.

As it is practically impossible to observe a platypus actually suckling her young, I was compelled to revert my attention to what I considered to be the next best thing, and that was to use a "teatless-dummy," a device arranged to represent the abdomen, etc., of an adult platypus. This completed, I saturated the centre of it with a semi-liquid preparation called "Platypus pap," a concoction I had previously accustomed my subject to relish.

After I had squatted the baby platypus in a natural attitude over the dummy, he at once grabbed the thing with his fore-paws and eagerly sucked up the surface slop, and, then, anxious for more, he stretched his neck forward and repeatedly scored the dummy with his lip tips. This he did by drawing them strenuously towards the supposed outlets, which were then situated between his fore-paws, and from which he had just received nourishment. But after proving it to be a dry area he, apparently annoyed, actually got his back up, and, clinging to dummy by all fours, he stiffened up and curled his tail to form the letter S well over his back. So rigid had become the tail that I was able to lift him bodily into space simply by inserting my finger beneath the semi-prehensile turn of the tail. I am not endeavouring to make a greater paradox of *Ornithorhynchus*

than he is said to be, by hinting at the prehensory possibilities of his trowel-like appendage. Too much has been "framed up" in that direction already. What I want to do is to point out that cat-like extent of rigidity that can be brought to bear by a platypus, right throughout the entire length of its vertebrate column when occasion arises. The occasion in this instance was due solely to anger caused by the creature being deprived of its pap.

The more I coaxed my patient by mimicking the plaintive call of its mother (made by her on similar occasions) the more he humped his back and stiffened, and when I scolded him for doing so (with mammy-like imitations) he just refused to have anything more to do, either with me or the dummy, but quietly relaxed his tense attitude and waddled away. So much for my mimicry! However, the following morning I put him to the test again, and he acted similarly to the way already described. The only exception was that when he lost all patience with the dummy he gave it a final vicious pull with his lip that ended with a slap to the chest. This was just such another action as that applied by an adult when flexing the bill violently to the chest prior to sounding in the water. In the case of my "patient," however, the bill remained locked to the chest and could not be pulled away without my applying what I considered to be undue treatment. When I endeavoured to work my finger beneath the bill to prise it from his chest, he only stiffened the more, and, embracing portion of the dummy the while, balled up in the tense attitude adopted by an *Echidna* when molested. After experimenting with both *Monotremes* at that age (three months) I find that the strength of both, in this respect, is about equal. To impart some idea of how strenuous and severe the lip-scoring could possibly be if applied to the abdomen of the mother, the following statement may suffice: Should gritty mud occur in a food receptacle from which the "scorer" is applying its method of gland draining, the result will be a pair of very sore lips for the scorer. Just as the dummy was treated, so the milk-glands of the mother would be, providing the "scorer" happened to be just as hungry as my patient was (a condition which, I fear, is often the case during lean periods). It will be remembered that the mother has but two perforated zones for her milk to ooze through, and that twins are a normal brood for her to nurse. Triplets are rare, while one occasionally occurs. Therefore, where one advanced "scorer" would be on velvet, so to speak, three would probably be on short rations, unless, of course, foodstuffs other than milk, such as cheek-pouched pap, be supplied occasionally by the mother.

On five occasions I have taken from nests material pertaining to triplets, from intra-uterine eggs to nestlings in pelage. I mention this because, probably, on the many occasions where I have collected nestling twins a third one may have died prior to my investigations. However, if a death had occurred through malnutrition, or otherwise, probably the mother would have either brushed it out with her tail or carried it in her mouth, not only from the nest, but completely out of the tunnel. Only once have I discovered the remains (a cranium) of a nestling in a breeding burrow. (This was taken to the Smithsonian Institute, Washington, U.S.A.).

To return to normal conditions, i.e., a mother suckling twins, I find that each "scorer" would have an equal opportunity of faring well at the fountains of life. Both could receive nourishment simultaneously if necessary, even though they reversed their positions occasionally. Indeed, this they would have to do in order to completely drain, from breast to

flank, the contents of the glands through their central apertures. Of course, the mother could assist them considerably to accomplish this task, by twisting and turning as she so desired to cope with the occasion. For instance, if she balled up in a squatting attitude it would tend to lessen the distance for "scoring" that would be necessary were she to stretch out upon her back, or straddle her up-turned "scorers" the while.

Now, seeing that the gland area at its full could no more than accommodate two "scorers" at a time, and that any interference by a third one during that period would only make the two hug more tightly the abdomen of the mother (just as my patient hugged his dummy) where would the third sucker come in? I say sucker in this case because scoring would be apart from the question; therefore, all it could do would be to nuzzle in occasionally for the overflow. This it no doubt could do, and probably does do, but I fancy the same sucker would not be content to play the part of outsider every time, unless it were a weakling doomed to remain a runt.

For the benefit of embryos, especially those not of robust nature, I believe the mother could induce her milk to flow by balling up and deliberately handling her own abdomen. I have repeatedly milked a mammy platypus, and this against her will, by a slight pressure of my finger and thumb. Indeed, if necessary, she could actually suck her own perforations for a like purpose. The possibility of her being able to do so at will is beyond contradiction. For, unlike most other mammals, adult platypus are toothless, semi-sucking creatures, and are capable of contorting themselves readily into postures that even the Echidna (because of its bristles) could not imitate. Apart from that, I know (to my sorrow) that nestling platypus in captivity draw from their own intestines harmful waste products that ultimately proved fatal to them. This practice may be a natural trait of Monotremes, for even the Echidna nuzzles her occupied pouch occasionally in an attempt to keep it clean. In such cases, though, no foreign foodstuff is ejected to be again digested.

The assorted foodstuffs I gave to my captive brood of platypus was certainly to their taste, and without doubt they thrived on it until, I suppose, the assistance of a mother was found wanting. I, as foster-parent, did my utmost for them, but one cannot play that part and act as wet nurse in six different compartments of a weanery at the same time. Even if I could, to interfere during such periods would be courting trouble of an equally serious nature, for their nervous systems would not stand for it. As this paper will probably be the last I will submit for publication for some considerable time, I wish to point out here an unfortunate mistake that appears in *The Platypus*. I say unfortunate because, apart from my allowing it to slip into print, I am not responsible for the mishap. On page 158 of the book, it is stated that in walking, the two limbs of one side of a platypus are rotated outwards and forward together. This statement is incorrect. The platypus walks similarly to other quadrupeds, and the shuffling, sinuous motion is caused by the shortness of the creature's limbs having to uphold and simultaneously propel an unbalanced and cumbersome body, a trying task, which naturally exhausts the bearer if continued fast for long. Platypus, at large, do very little walking, and when they do, it is deliberate, slow, and stealthy. Such actions can best be detected in the movements of nestlings.

The statement referred to in *The Platypus* was submitted to me in galley copy, at a time when I was unable to secure a living specimen to make a personal test, and, as the book was due for launching before I was

able to go afield and collect a specimen, I was only too glad to accept the statement made from observations at Sydney University. As a matter of fact, I supplied the live platypus for others to observe, both for their benefit and my own. The cause of the incorrect calculations, I think, was the fact that the specimen supplied was becoming demented through being handled too frequently prior to my sending it along, and probably because of it receiving similar treatment at the University during the trying time it had there.

An agitated and disgruntled platypus, if tantalised and compelled to put up a performance against its will, especially when in a weak state, will, when attempting to regain freedom from unnatural surroundings, blunder along at any gait, and actually fall over itself, so to speak, in the endeavour to lose sight of its tormentors. This evidently is what occurred at the test from which I culled my note for the book. Whatever that platypus did was anything but a natural gait, and can best be described as a scrambling, blundering attempt, as a last resource, to preserve its life. A terrified, submerged platypus also scrambles along through water, but obviously to no advantage other than to make it far more difficult for any pursuer to grab hold of its hind-parts (including legs) which, on normal occasions, trail at either side of the tail.

II. OBSERVATIONS ON PLATYPUS GRIPS.

By HARRY BURRELL, C.M.Z.S., F.R.Z.S.

Although the spurs of *Ornithorhynchus* are superficially similar to the solid spurs seen on the legs and wings of certain birds, they are so differently constructed that I have decided to term them "grips." This oscillating, dual-functioning pseudo-digit, as I know it, no more resembles a true spur than it does a true claw; therefore, those terms are no more applicable than "heel" is to the steel spur affixed to a game-cock.

Before attempting to shed light on the actual growth of the platypus grips, I may perhaps remark that their dual purposes will scarcely be touched upon in the present paper. For fuller particulars of this subject see *The Platypus* (Angus and Robertson, Sydney, 1927). In that work Shaw is quoted as including the spur as a sixth digit. This may be a fairly accurate description of it, but apart from its being a movable member there is little to commend it for such classification. Probably the term "pseudo-digit" will be more fitting.

When platypus are hatched from the eggs (if not prior to this astonishing event) indications of grips can be seen on the legs, just above the feet of both sexes. These continue gradually to grow in the case of the female up to the age of six weeks, and in that of the male for fully twice that period. During the first six weeks the difference of sex cannot be ascertained from the outward appearance of these protrusions, so alike are they. Throughout their growth they are brown, and at the full period of this interesting sexual phase project 4 mm. from quick to tip. The circumference at the base is 9 mm.

At approximately six weeks the protrusions of a female platypus commence to recede, and within a further six weeks the tips have reached the precise level whence they first emerged.

In the meantime, the true grip of the male is taking shape in quite another direction, and the apparently surface brown of the protrusion is now turning pale, gradually changing from brown to cream, and then bleaching to ivory-white. At this stage (three months old) my observations came to an abrupt end through the untimely deaths of my subjects.

This did not perturb me greatly, however, because I was then anxious to operate in order to ascertain if possible what changes were taking place within the now uniformly enlarged yet still stubbed projections. Before dissection, they appeared solid to the touch, so much so that I was contemplating adding a pair of these rare ivory-like grips to the Canberra collection. But this was not to be—not in that shape or form, anyway—for while dissecting them I discovered that the colour referred to was purely capsuled matter, the outer covering of which, though horny, was so thin and transparent that any colour could be readily transmitted through it, thus making it appear like the polished surface of its pigmented contents only. When removed from its compact “filling” it resembled a stubbed, conical cap, fairly brittle, but capable of being carefully depressed without causing fracture to its most delicate basal part. There is no filament or rim thickening around the base to prevent it slipping from its dermis-like fastening. In fact, with the exception of being completely surrounded by this quick, it evidently grows, and maintains its position throughout, just as scales and nails of other creatures are known to do.

The compact “filling” referred to was fairly firm and decidedly shaped—that is to say, according to the capacity and design of the receptacle allowed for its growth—and it resembled, both in colour and substance, the creamy flesh we find in the nipper of a small (cooked) crab. Embedded in the centre of this muscle-like mass, I discovered a semi-cylindrical, bone-like growth, which, in contour and design, constituted a miniature fac-simile of a matured grip. Measurements: Length, 8 mm.; diameter, at base, $1\frac{1}{2}$ mm.; nearing tip, where orifice would eventually appear, 1 mm.; length of solid puncturing point, 2 mm.

There was an aperture commencing from the base and continuing to about half the length; the rest as yet appeared solid. But there was no mistaking the fact that, ultimately, the aperture would be completed throughout, as is the case with the fully matured grip of a male. The intricate filament of bone that rings the base of the fully matured grip, and, incidentally, projects 3 mm. from it, was conspicuous by its absence (to the naked eye) in this instance, yet when moderately magnified was seen to be taking shape.

By judgment, then, this bony structure represented the core of the grip in the growing, and nothing else. But, seeing that it was the only section yet hardened, I suggest that, at that stage, the “filling” surrounding it may be classed as a form of nourishment and a protective factor combined during the delicate growth of the horny grip to be.

The maturing antlers of deer, when “in the velvet,” may possibly apply as a fair comparison. This being the case, one may surmise that the conical cap with its “filling” would gradually disintegrate after fulfilling this purpose. On the other hand, if the “filling” should finally fuse into the horny substance found in a matured grip, then I feel convinced that the substance of the core proper is of different composition. However, I fancy that the conical cap is nothing more than a protective capsule for the “filling,” and if it does not actually disintegrate then, I believe that it ultimately would be pushed off by the growth of the grip. Anyway, I cannot conceive that it would continue to grow and finally become the veneering to the matured horny weapon. That point, however, remains a secret awaiting further research; consequently my theory cannot yet be entertained as fact. Providing I succeed later in rearing platypus, even up to the tender age of six months, I anticipate that this and other problems will be overcome.

However, as a rung at a time is sufficient to climb, I return to the recessed tip of the female genital protrusion. "Tip" is the correct term to use here, for this was all of the cap that had remained brittle up to this juncture, and it was quite easily removed from position by a touch of a finger-nail. Apparently it would have fallen off of its own accord had the possessor lived a little longer under my supervision, or, better still, had she been at large the while.

But what is puzzling me most is this: Seeing that both sexes possess similar projections up to a given age, if the "filling" found in the male capsule goes to form horn, what becomes of the "filling" of the female's capsule? Of course, it is open to question whether it consists of similar substance or not, but, as I can find no evidence to prove that it does not, I will continue with the theory that it does. Again I ask, then, what becomes of it? It certainly does not harden into horn; nor does it nourish the growth of a horny grip, for the obvious reason that a female does not show a horny grip at any age. Therefore, solidification is quite out of the question. One may imagine, perhaps, that it either disintegrates gradually or finally softens to form, in contorted folds, the so-called socket peculiar to the sex.

I find that early anatomists, who had only adult carcasses to work upon, were compelled to theorise on such material as was available, and, evidently basing their faith entirely upon anatomical probabilities (as some do to this day), came to conclusions that may yet prove erroneous. For instance, this socket has been referred to by Home as a regular socket, adapted to the reception of the spur. Bauer, another reliable investigator, writes: "This socket corresponds exactly in shape to the spur itself." Knox and Owen have shown that these depressions in the female are merely the rudiments of the male spur, which disappears "prior to the dawn of sexual life." Judging by the above statements, these anatomists came to the conclusion that the grip of the female, like that of the male, developed to the full before collapsing within itself to form the socket. The words "prior to the dawn of sexual life" are sufficiently convincing in themselves to make that point clear. Granted that those investigators were restricted to adult spirit specimens, why did they ignore the probabilities of the female being spurless throughout life? This they evidently did, and notwithstanding the fact that, at that time, the platypus was considered to be more BIRD-like than it is thought to be to-day. I stress this point lest it be overlooked in the summing-up of the present paper.

As I am now working on material that was not then available, let me furnish others with information that, I am convinced, was unknown prior to my experimenting with nestling platypus in captivity, last year. To begin with, I offer the definite assurance that not at any time during life does a female platypus possess horny grips. During the first two months of her existence she certainly displays budding projections, but these never develop, anteriorly, beyond that stage. This point being settled, I can do no better than relate what I have observed since my previous hypothesis on this subject. On dissecting this very deceptive growth (a tedious task) I found the so-called socket permanently affixed in irregular folds of a gristly nature, and only when this calloused mass was wholly removed and semi-relaxed did it appear sac-like, a shape, I think, impossible for the animal to accomplish by muscular exertion, even during the period of coition excitement. At any rate, this could only be brought about by some uncanny contorting of the ankle muscles that might cause the entire sac with its gristly folds to pout, as it were, from its calloused setting. Assum-

ing that such a feat be within the bounds of possibility, then the sac may be regarded as a vacuum-grip to act upon the male grip, as a gaping anemone sucks an inserted finger. Otherwise, the thing is not practicable. For, even granting the possibility of this extraordinary feat being accomplished at will, the sac of an adult could not, though extended to the utmost, accommodate more than a third of the length of a matured grip without the point of that weapon penetrating it, only to lodge between the bare bones that cradle the seat of the sac. (Similar bones cradle the venom-cyst of a male). Consequently, rather than place faith in any theoretical views that have been advanced in favour of the socket being used as a receptacle for the grip, I prefer to adhere to the statement I made in *The Platypus*, viz.: "This so-called socket can best be likened to a calloused area about the ankles, corresponding in dimensions with the base of the male grip. This, then, in the case of the female, would prevent the grip tip from pricking, even accidentally, the ankle."

After weighing all evidence at my disposal, including the observations set out here, I have come to the following conclusions: The "filling" of the female genital protrusion after maturing to the full within a protective capsule gradually recedes to form the calloused area referred to, which includes the depressed gristly folds, while the cap disintegrates, leaving the whole in an indefinite, if not functionless, form. As regards the "filling" contained in the cap of the grip, judging by the condition of it at the time of examination, I venture to state that after fulfilling an essential host-like purpose, or, at least, acting as a protective substance to the maturing grip, which ultimately pierces it entirely by its ever-prodding point, it recedes. Then it mingles with the intricate bony ring now rapidly developing at the base of the grip, thus forming the cartilage that will function later as a hinge to that oscillating member. When completely fused to the principal tendons of that area it will serve to prevent sprain, or dislocation, when the grip is being strenuously used.

After the grip completely punctures the "filling" (and that substance has been drawn upon as described) it probably forces the cap off holubolus in its quickening to maturity. Otherwise, the cap would become punctured also, instead of being gradually drawn from the quick where it may, if left to chance, cause irritation to the now advancing sheath that, ultimately, envelops a considerable portion of the base of the grip. Fortunately (or naturally) the tip is the most solid portion of the cap; therefore, in this case it would act as a reinforced rather than a fragile point of resistance against the shoving that is taking place to dislodge it whole. However, I do not think that the cap disintegrates, for its usefulness, as a protective covering, is maintained for fully twice the length of time of that required of the female's; and it develops uniformly to greater dimensions before these functions end.

The grip and sac examined were dissected from well-fixed spirit specimens, consequently some allowance should be made when imagining what condition the substance which I term "filling" was in before being fixed. For example, it may prove to be more of a glutinous nature during life than it was when I found it. Probably it is a substance that will readily liquefy when drawn upon for final requirements. At any rate, I do know that in the male genital protrusions of the living animal, the colour changes occur exactly as I have stated—from brown to ivory-white. Whether I am right or wrong in my theories remains to be proved, but if I have created nothing more than a starting-point for others, then I have, at least, supplied the key to a dead-lock.

THE LORICATES OF THE NEOZELANIC REGION.

By TOM IREDALE, Conchologist, and A. F. BASSET HULL,
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Continued from page 76.

VII. Family PLAXIPHORIDAE.

This family is characteristic of the Neozelanic Region, its members ranging from small to large, and comprising one of the smallest degenerate forms, and one of the largest Loricates known.

The family is circum-Antarctic and south temperate, ranging in very degenerate forms into the Tropics. North American shells, which have a superficial resemblance, belong to the family MOPALIIDAE, and the Neozelanic shells, though not closely related, have sometimes been referred to that family. The striking features of the group are the girdle characters and the posterior valve. The girdle is leathery, with sutural pores and corneous processes, or (in one genus only) scales, the posterior valve showing no projecting insertion plate. The anterior valve is always eight-slit, thus separating the family widely from the five-slit Cryptoconchids. It is very possible that the genera are not so closely allied phylogenetically as here placed, but a great deal of research is necessary in microscopic details to improve the classification. It is obvious that *Guildingia* is not very near to *Maorichiton*, while the latter has been confused with the Australian genus, *Poneroplax*.

The genera here admitted agree in having the anterior valve eight-slit, the median valves with one slit on each side, the insertion plate of the posterior valve reduced to an unslit callus, the teeth all long and not pectinated. The girdle covering shows tufts of corneous processes at sutural pores, and similar corneous processes scattered more or less thickly over the remaining surface. The external sculpture of the valves, a very characteristic feature of Loricata groups, varies in the genera. By this means the groups can be easily separated, as follows:—

- External sculpture weak, shell very large *Plaxiphora*.
External sculpture with nodulous radials and wavy lines,
sutural laminae continuous *Diaphoroplax*.
sutural laminae separate *Maorichiton*.
External sculpture very fine wrinkles, radials obsolete,
girdle covering scales *Vaferichiton*.
External sculpture obsolete, size very small *Hemiarthrum*.
External sculpture none, shell large and glossy *Guildingia*.
External sculpture very pronounced, mucro of posterior
valve upturned *Frembleya*.

xiii. Genus PLAXIPHORA.

1847. *Plaxiphora* Gray, P.Z.S., 1847, 65, 68, 169. Type by monotypy *Chiton carmichaelis* Wood = *aurata* Spalowsky.
1853. *Euplaxiphora* Shuttleworth, Mittheil. Naturf. Gesell. Berne, 193.
New name for *Plaxiphora* Gray.

Shells very large, oval, very weak sculpture, girdle large, leathery, with few scattered corneous processes, and sutural tufts of a few corneous processes; anterior valve with eight indistinct radial ribs over-ridden by concentric growth wrinkles; an indistinct similar rib separating the lateral areas of the median valves; posterior valve with mucro a little in front of

the extremity of the valve, a posterior area being indicated, the same concentric sculpture as in the median and anterior valves. The sutural laminae and anterior insertion plate very large, the former practically discontinuous and one-slit, the latter eight-slit, no pectination; a strong callus developed in the posterior plate, a distinct medial sinus being present.

39. PLAXIPHORA AURATA.

(Plate vii., figs. 1-5.)

1795. *Chiton auratus* Spalowsky, Prodr. Syst. Nat. Test, 88, pl. 13, figs. 6a-b. "Die Südsee" = Falkland Islands.
1825. *Chiton rariolosus* Blainville, Dict. Sci. Nat. (Levr.), xxxvi., 547. Habitat unknown. Type in Coll. Blainville ex Leach.
1828. *Chiton carmichaelis* Wood, Index Test. Suppl., pl. 1, fig. 10 (pref. dated May 17). Cape of Good Hope. Type in Brit. Mus. (name ex Gray MS.).
1828. *Chiton carmichaelis* Gray, Spicil. Zool., pt. 1, p. 6 (dated July 1). Same specimen as of Wood.
1831. *Chiton setiger* King, Zool. Journ., V., 338. Tierra del Fuego. Type in Brit. Mus.
1880. *Toncia atrata* Hutton, Man. N.Z. Moll., 114 (not of Sowerby). Macquarie Island.
1880. *Plaxifora campbelli* Filhol, Comptes Rendus Acad. Sci. (Paris), xci., 1095. Campbell Island, N.Z. Type in Paris Mus.
1881. *Choetopleura savatieri* Rochebrune, Bull. Soc. Philom., Paris, Ser. vii., Vol. v., 119. Straits of Magellan. Type in Paris Mus.
1884. *Choetopleura hahni* Rochebrune, Bull. Soc. Philom., Paris, Ser. vii., Vol. viii., 34. Patagonia. Type in Paris Mus.
1885. *Plaxiphora campbelli* Filhol, Miss. l'île Campbell, iii., 2, 540.
1889. *Chaetopleura rariolosa* Rochebrune, Miss. Sci. Cap. Horn, vi., Moll. H., 135 (= *setiger* King; two valves of type in Paris Mus. examined).
1889. *Chaetopleura hahni*, *id. ib.*, H., 136, pl. ix., fig. 4.
1889. *Chaetopleura savatieri*, *id. ib.*, H., 136, pl. ix., fig. 3.
1889. *Chaetopleura frigida*, *id. ib.*, H., 137, pl. ix., fig. 5. Patagonia (juvenile showing nodulous radial sculpture). Type in Paris Mus.
1893. *Toncia subatrata* Pilsbry, Man. Conch., xiv., 201. New name for *Toncia atrata* Hutton, 1880, Macquarie Island.
1893. *Plaxiphora superba* Pilsbry, Man. Conch., xiv., 319, pl. 68, figs. 55-61, ex Carpenter MS. New Zealand. Type in Brit. Mus.
1893. *Plaxifora campbelli* Pilsbry, Man. Conch., xv., 107. Translation of Filhol's early description.
1893. *Chiton rariolosus* Pilsbry, Man. Conch., xv., 116. Translation of Blainville's description.
1897. *Plaxiphora superba* Suter, Proc. Mal. Soc., ii., 188.
1897. *Plaxiphora subatrata* Suter, *id. ib.*, 190, figs. 7-11 in text (ex Pilsbry as new name).
1904. *Plaxiphora superba* Hutton, Index Faunae N.Z., 87.
1904. *Plaxiphora subatrata*, *id. ib.*
1905. *Plaxiphora subatrata* Hamilton, Col. Mus. Bull., No. 1, 36.
1909. *Plaxiphora aucklandica* Suter, Subant. Isl. N.Z., 2, pl. i., fig. 1 (December 22). Auckland Is. (juvenile specimen). Type in Canterbury Mus., Christchurch.
1909. *Plaxiphora superba*, *id. ib.*, 3.

1909. *Plaxiphora campbelli* Thiele, Rev. Chiton., pt. 1 (Chun's Zool., heft. 56), 27, pl. iii., figs. 39-40 (valves fig.).
1910. *Plaxiphora campbelli* Iredale, Proc. Malac. Soc., ix., 94, 95.
1911. *Plaxiphora aurata* Pilsbry, Nautilus, xxv., 36.
1913. *Plaxiphora aucklandica* Suter, Man. Moll. N.Z., 18. Atlas, pl. 3, fig. 10.
1913. *Plaxiphora superba* Suter, id. ib., 21. Atlas, pl. 2, fig. 6; pl. 3, fig. 14; 1077; pl. 32, fig. 11; 1079.
1914. *Plaxiphora aucklandica* Iredale, Proc. Malac. Soc., xi., 31 (= *campbelli*).
1915. *Plaxiphora aurata* Iredale, Trans. N.Z. Inst., 47, 1914, 420, 424.
1916. *Plaxiphora aurea* (sic) Hedley, Austr. Antarct. Exped., 1911-1914, Sci. Rep. Ser. c., Zool. iv., 35 (November 6). Macquarie Island.
1917. *Plaxiphora campbelli* Dupuis, Bull. Mus. Nat. d'Hist. Nat. (Paris), 534 (type examined).
1917. *Plaxiphora raripilosa*, id. ib., 535 (type in Paris Mus. examined!).
1922. *Plaxiphora raripilosa* Ashby, Trans. Roy. Soc. South Austr., xlv., 576 (type examined!!).
1924. *Plaxiphora raripilosa* Odhner, Vidensk. Medd. Dansk. Nat. Foren. Bd., 77 (N.Z. Moll.), 8. (North Is., Auckland I., Campbell I.).
1926. *Plaxiphora aurata* Finlay, Trans. New Zeal. Inst., 57, 333.

We do not propose to deal with the curious nomination of the South American form in detail, but will give the history of the Neozelanic names.

Thus Hutton in 1880 included *Tonicia atrata* Sowerby, copying Reeve's description, but added: "Our species (from Macquarie Island) agrees very well with Reeve's figure, but not with his description. The anterior terminal area is distantly radiately ribbed, and the lateral areas are sometimes defined by a single rib. The umbone of the posterior valve is more posterior than in the drawing, and the valves are of a uniform brown colour. The mantle is of the same colour as the valves. Sowerby gives the Falkland Islands as the locality for this species, but Reeve doubts it and gives no habitat at all."

The same year Filhol described *Plaxifora campbelli* very shortly. Translated by Pilsbry, his description reads: "Allied to *P. biramosa* Quoy, but differing in the greenish colour, by the last valve being covered with projecting concentric lines, and by the presence of very bushy bunches of hairs, not binary. Campbell Island."

No specimen has been seen with very bushy bunches of hairs, but the detailed description Filhol gave a year or two later left no doubt as to the applicability of the name, as was later recognised by examination of the type.

In the Manual of Conchology, Pilsbry reproduced Hutton's remarks, given above, under *Tonicia atrata*, and added: "These characters seem to me to indicate a distinct species, which may be called *Tonicia subatrata*."

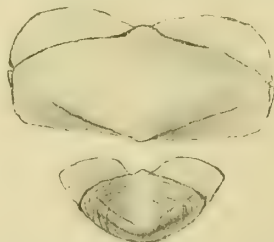
Further on he introduced *Plaxiphora superba* solely from Carpenter's MS. description and figures, as follows: "Shell large, oval, elevated, the dorsal ridge acute; mucro subposterior, little elevated. Reddish-olive, maculated with darker and paler. Valves nearly rectangular, but well indented at the sutures, having a 'false apex' in front. Lateral areas having indistinct, subobsolete radiating riblets. Anterior valve subangled by eight radii, which slightly undulate the peripheral margin; otherwise nearly smooth, except for growth lines. Interior: posterior valve having the insertion-plate elevated, rounded, interrupted in the middle behind by a

very narrow, deep sinus. Anterior valve having eight, central valves one slit, teeth long, slightly striated and slightly thickened at the edges of the slits outside. Sinus narrow, short. Sutural laminae continuous over the anterior false apex. Girdle tough, black, leathery, hardly sinuated behind, smooth, with a few bristles at the sutures and around the margin. Length 60, breadth 40 mm., divergence 110°. New Zealand."

Pilsbry then relegated *Plaxifora campbelli* Filhol, to the list of insufficiently described Chitons, overlooking Filhol's extended and accurate description, published a little later than the brief diagnosis above quoted. Under the same heading he translated the description of *Chiton rari-pilosus* Blainville, as follows: "Body oval, thick, convex, not carinated; girdle moderate, beset with large black flexible hairs, a little more numerous around the periphery. Shell of 8 thick valves, a little carinated; the two end valves a little smaller, the anterior semicircular, with 9 large teeth of insertion, the posterior transversely oval, with the insertion-plate entire, winged anteriorly; intermediate valves alike, having a rounded projection in the middle of the anterior border; the plate of insertion somewhat winged, with a single deep slit on each side. Colour, brown on the girdle, the valves russet white outside and within. Length more than 3 inches. Habitat unknown. (Coll. Blainv. from Dr. Leach). Seems to be a *Plaxiphora*. Rochebrune has identified it with *Chiton setiger* King (Polyplac., Cape Horn, 1889)."

When Suter four years later reviewed the Neozelanic Loricates he admitted *P. superba* from Pilsbry's description, and then fully described *Plaxiphora subatrata*, following up Pilsbry's indication of his *Tonicia subatrata*, thus: "Shell large, oval, moderately elevated; side slopes slightly arched; ridge rounded. Colour reddish-brown, dirty-pink at the jugum. The head valve strongly concentrically ridged, and with eight radiate ribs, which, however, sometimes become obsolete. Central valves beaked anteriorly and posteriorly; the anterior beak is rather prominent, rounded, the posterior one pointed, forming an angle of about 120°, and is formed by the outer layer only. The whole surface of the median valves is strongly concentrically striated, following the outline of the anterior beak over the jugum. Lateral areas distinct, raised, with two ribs, which are sometimes flatly nodulous, owing to their being crossed by concentric lines; in some specimens the diagonal ribs are only very faint, or disappear alto-

Copy of Thiele's figures of
Plaxiphora campbelli
Filhol (type).



gether; on the other hand, their number may increase to four, but the anterior and slit-rib are always the more prominent. Posterior valve small, depressed, concentrically ridged, slightly beaked anteriorly; mucro inconspicuous, terminal. Interior white, tinged with light-blue. Sinus shallow, rounded. Sutural laminae rather broadly rounded. Insertion-

plates low. Anterior valve with eight irregularly distributed slits; teeth sharp, striated on the outer side; the whole of the interior light-blue. Intermediate valves with one slit on each side; posterior tooth broad; a strong light-blue callosity extends between the two anterior teeth. Posterior valve with the insertion-plate thick, rounded, without slits, a small sinus in the middle behind. In all valves the eaves are very narrow and spongy. Girdle wide, narrower at both ends, leathery, tan-colour, dark brown when dry; at each suture a pore with long corneous bristles, six in a tuft, and alternating with these pores a second row of smaller ones is situated near the margin. In front of head and tail valve six smaller pores with short bristles. The margin beset with horny bristles of varying size. Length 75, breadth 45 mm., divergence 125° (spirit specimen). A specimen from Campbell Island, belonging undoubtedly to the same species, is of olive-brown colour, the jugum horny-yellow. The anterior valve has well-pronounced radiating riblets, the concentric lines on all the valves are less distinct, and the posterior beak on the central valves is almost obsolete. The ribs on the lateral area of the intermediate valves do not run down to the margin, but are intercepted by a broad, smooth, concentric band, extending along the sides and anterior part of the valves. The valves are more depressed, divergence 135° . Habitat, Macquarie Island, Campbell Island."

The specific name *subatrata* then came into use, while *superba* was left indefinite.

A most unaccountable lapse was made by Suter when he described a juvenile as *Plaxiphora aucklandica*: "Shell small, elongately oval, depressed, valves very fragile (animal preserved in formol!), dorsal ridge subangular. Colour light brown, jugal tract whitish, white dashes on the sides. Girdle wide, black, with sutural tufts of very long bristles. Anterior valve short and broad, flattish, with eight granulated radial ribs. Intermediate valves wide, depressed, the jugum smooth, with very fine growth lines; lateral areas not raised, with two narrow granulated ribs, the interspaces smooth. Posterior valve smooth, small, the mucro posterior, the hind slope nearly straight. Girdle broad, with very prominent sutural tufts round the anterior and a few round the posterior valve; a second series of tufts with shorter bristles near the margin, which is beset with short brownish hairs: remainder of the girdle quite naked, smooth. Colour of the valves light brown; intermediate and tail valves usually with a dorsal triangular white area, with a longitudinal brown median line; one or two white elongated spots are mostly present on the pleural, rarely on the lateral area; girdle black. Length, about 15 mm. Divergence, 105° . The specimen could not be disarticulated without completely destroying the valves. Habitat: Musgrave Harbour, Auckland Islands."

In the meanwhile the South American "*setiger*" had been identified by Sykes as the same shell Gray had described from the Cape of Good Hope as *carmichaelis*, which had been figured by Wood. Iredale, working at the British Museum, confirmed this determination, and also Thiele's separation of the two Neozelanic species confused under *biramosa*, and used for the second species *campbelli* Filhol = *superba* Pilsbry = *subatrata* Pilsbry, as of Suter. Receiving many specimens from the Falkland Islands, Iredale could not separate these, and therefore concluded that the South American name should be used for the Neozelanic shells. However, Pilsbry pointed out that Spalowsky had, many years previously, given a beautiful figure of this species, under the name *C. auratus*, the locality, "Die Südsee," being written, but obviously a Falkland Island shell, figured. Consequently,

Iredale advocated *P. aurata*, citing as synonyms, *carmichaelis*, *setiger*, *campbelli*, *savatieri*, *hahni*, *frigida*, *superba*, *subatrata* and *aucklandicu*. A few years later Dupuis, overlooking Iredale's paper, revived *raripilosa* for *setiger*, pointing out that Rochebrune had previously noted this identity. Dupuis also added *veneris* Rochebrune, but the description absolutely forbids this, as "central areas sulcate, the sulci imbricating," is not a feature of the present shell. Rochebrune had mentioned that two valves of Blainville's type of *raripilosa* were in the Paris Museum, and Dupuis also accepted, and Ashby commented upon the type, but according to Blainville his specimen was in his own collection, not in the Paris Museum.

Comparison of the huge Macquarie Island shells with the Falkland Islands species still maintains their very close relationship, and if any differential value can be given at present at most it would be subspecific. As above noted, there are plenty of synonyms and the species is very easily recognisable. The preceding descriptions give all the characters necessary, and we will only add the note that the immature show the lateral ribs, and the faint ribbing on the anterior valve to have a slight but distinct nodulose character. Suter's juvenile "*aucklandica*" was only 15 mm., while it ranges as adult to 120 mm.

Station: On rocks in littoral zone; under surface of stones at low water.

Though common and conspicuous at the sub-Antarctic Islands, it is not well known from the mainland, though it has been recorded from there.

xiv. Genus MAORICHTON.

1914. *Maorichiton* Iredale, Proc. Mal. Soc., xi., 32, March. Type by original designation *Chiton caelatus* Reeve.

Iredale introduced this subgenerically with the definition: "The small size, definite sculpture, and peculiar posterior valve determine this subgenus; the tegmentum of the posterior valve ends in a pointed plane mucro forming a triangle.

"Shells small, elongate oval, depressed, girdle with corneous processes generally bunched at the pores, sometimes scattered over the surface; posterior valve with mucro terminal; external sculpture coarse. General features as in *Plaxiphora*."

The species of *Maorichiton* are not well distinguished, as the sculpture varies in degree, and young ones are sometimes well sculptured and sometimes nearly smooth. Intensive collecting may solve the problem of the species, the so-called '*zigzag*' being still a puzzle.

40. MAORICHTON CAELATUS.

(Plate vii., figs. 6, 7.)

- 1847. *Chiton caelatus* Reeve, Conch. Icon., iv., pl. xvii., sp. & fig. 101. New Zealand. Type in British Museum.
- 1872. *Tonicia zigzag* Hutton, Trans. New Zeal. Inst., iv., 1871, 180. Hab. ? = N.Z. Type in Dominion Museum, Wellington.
- 1873. *Acanthopleura caelatus* Hutton, Cat. Marine Moll. N.Z., 49.
- 1874. *Chiton (Plaxiphora) terminalis* Smith, Zool. Voy. Erebus & Terror, Mollusca, 4, pl. 1, fig. 13, ex Cpr. MS. (Coll. Capt. Bolton and Stokes). New Zealand (restricted locality), Auckland. Type in British Museum.
- 1880. *Acanthopleura caelata* Hutton, Man. N.Z. Moll., p. 115 (= *zigzag olim*).
- 1880. *Mopalia ciliata* Hutton, *id. ib.*, 116.

1880. *Plaxiphora terminalis* Hutton, *id. ib.*, 116.
 1893. *Plaxiphora terminalis* Pilsbry, Man. Conch., xiv., 326, pl. 51, fig. 14.
 1893. *Plaxiphora terminalis* var. *zigzag* Pilsbry, Man. Conch., xiv., 327, ex Carpenter MS. New Zealand. Type in British Museum.
 1893. *Plaxiphora caelata* Pilsbry, Man. Conch., xiv., 328, pl. lviii., figs. 21-22.
 1893. *Streptochiton cupreus*, *id. ib.*, "ex Cpr. MS. olim," as synonym.
 1897. *Plaxiphora caelata* Suter, Proc. Malac. Soc., ii., 189, July.
 1904. *Plaxiphora caelata* Hutton, Index Faunae N.Z., 87.
 1905. *Plaxiphora caelata* Hamilton, Col. Mus. Bull., No. 1, 36.
 1910. *Plaxiphora caelata* Iredale, Proc. Mal. Soc., ix., 92. June.
 1913. *Plaxiphora caelata* Suter, Man. N.Z. Moll., 19. Atlas, pl. 2, fig. 5. 1098.
 1913. *Plaxiphora terminalis* Suter, Man. N.Z. Moll., 1078.
 1915. *Plaxiphora caelata* Iredale, Trans. N.Z. Inst., 47, 1914, 424.
 1921. *Plaxiphora* (*Maorichiton*) *lyallensis* Mestayer, Trans. New Zeal. Inst., liii., 1920, 176, pl. xxxviii., figs. 7-8. July 4, 1921. Lyall Bay, Cook Strait, Wellington. Type in Dominion Museum, Wellington.
 1924. *Plaxiphora caelata* Odhner, Vidensk. Medd. Dansk. Nat. Foren. Bd., 77 (N.Z. Moll.), 8. North Island.
 1926. *Plaxiphora zigzag* Mestayer, Trans. N.Z. Inst., 56, 584, pl. 100, figs. 5-6. Type figured.

Reeve's description reads: "Shell oblong-ovate, somewhat attenuated anteriorly, terminal valves, the posterior of which is small and slanting, and lateral areas of the rest broad-ribbed and neatly curved with close-set waved laminae; central areas very minutely reticulated; beautifully ornamented with green and pink; ligament horny, here and there bristly. Hab., New Zealand, Earle."

"Care must be taken not to confound this beautiful species with the *C. setosus*."

Nearly thirty years later Smith described *Chiton terminalis*: "Shell elongately ovate, rather elevated, roundly angled along the top of the valves, black or bluish-black, with a white wedge-shaped stripe, with a black one within it down the centre of the valves, forming a continuous white stripe, divided by a black one along the centre of the shell; in some specimens with a few short white dashes diverging from the radiating ridges. The intermediate valves mucronated, bisected on each side by one raised radiating rib, the posterior margins sinuated and thickened by coarse concentric lamellae; the entire surface is covered with minute striate-wrinkling, those near the ridge being coarser than the rest and radiating from it like the webs from the shaft of a feather. The posterior terminal valve has the mucro quite terminal. The anterior valve radiately eight-ribbed (at times one or two additional minor ones are present), with diverging oblique striations on each side of them. Interior of valves greenish-blue; valve lobes whitish, the sinus between them deep; the hairs or bristles on the mantle-margin are short, few and horny, those arising from the nine pores being thicker than the rest. Largest specimen (in a contracted state), 42 mm. long; width of valves 20. An average specimen. Length, 25 mm.; width, 11. Habitat: New Zealand (Coll. Bolton and Capt. Stokes). The central white stripe with the black one within it appears to be very constant."

A couple of years before Hutton had described *Tonicia zigzag*: "Oblong; mantle slightly tomentose; valves slightly flattened on each side, but not

keeled; posterior margins sloping backwards into a point, crenulated on the sides; anterior valve with nine radiating ridges, crossed by fine concentric zigzag striae; lateral areas with two on each side; radiating ridges crossed by fine zigzag striae; posterior and median areas with very fine oblique striae, diverging from the dorsal line outwards and forwards, crossed by others diverging outwards and backwards, forming an "engine-turned" pattern. Length, .88 inch; breadth, .31 inch. Colour: Mantle white, valves greyish black, with a white stripe on each side of the dorsal line; interior greenish blue. A single specimen is in the Colonial Museum; locality not stated."

Hutton sank his *zigzag* as a synonym of *caelata*, but Pilsbry questioned this, and Iredale revived Hutton's name for a little species from Lyttelton, but Miss Mestayer has figured Hutton's type, and it is quite referable to *caelata*. Smith's *terminalis* was exactly a synonym, and this is explained by the fact that Carpenter had described in MS. shells in the British Museum as *Streptochiton cupreus*, which he afterwards determined as Reeve's *caelata*. These specimens were used by Smith for comparison, and were undoubtedly different from his *terminalis*, as they were *biramosa* Quoy and Gaimard.

Recently, Miss Mestayer has described *P. lyallensis* thus: "Shell oval, flatly arched, side slopes straight, surface dull. Anterior valve with eight radial ribs, rendered slightly nodulous by the irregularly spaced growth lines; the spaces between the radials appear smooth, but a strong pocket lens shows traces of V-like sculpture. Median valves squarish, not beaked, nearly smooth; lateral areas raised, marked off by a strong semi-nodulous rib, the central portion covered with very fine V-like sculpture; the jugal areas with traces of microscopic striae and pitting; the pleural areas with a few horizontal wrinkles in a shallow groove anterior to the lateral rib; this groove is most distinct in valves 4 to 6. Posterior valve small, mucro terminal, slightly upturned; pleural areas bounded by a strong marginal rib, no sculpture. Interior deep blue-green, sutural plates white, sinus rather broad, convex in centre, with a central dark brown spot and a yellow tinge on either side of it. The anterior valve has eight slits, the edges of which are thickened and upturned; the insertion plates lightly grooved. The median valves also have the insertion-plates grooved and one-slit. The posterior valve has a thickened rib-like insertion-plate. Colour: Ground-colour, greenish-brown, irregularly barred with cream, the sixth valve cream, with irregular zigzags of the ground colour; the anterior valve uniform brown. Girdle moderately broad, with a marginal fringe of soft short bristles, and about twenty tufts and pores adjoining the valves; when alive it was a greenish colour. Measurements: Length, 35 mm.; breadth, 20 mm. Lyall Bay, Cook Strait, New Zealand."

Through the courtesy of the Director of the Dominion Museum we have been enabled to examine this specimen, and find it is merely a smooth aberration of the common species.

Station: Under stones between tide marks.

41. MAORICHITON METONOMAZUS, *sp. nov.*

1909. *Plaxiphora* sp. Thiele, Rev. Chitonon, Chun's Zool., heft. 56, 28, pl. iii., figs. 46, 47. Lyttelton, N.Z., in Hamburg Museum.
 1914. *Plaxiphora* (*Maorichiton*) *zigzag* Iredale, Proc. Malac. Soc., xi., 34. March. Lyttelton, N.Z.
 1915. *Plaxiphora zigzag* Iredale, Trans. N.Z. Inst., 47, 1914, 421, 424.



Copy of Thiele's figures.

Thiele described a small shell from Lyttelton, and Iredale determined it from the description as Hutton's *zigzag*, but Miss Mestayer's figure of Hutton's type shows this to be incorrect. We assign a name to the shell, which may be found later to be more distinct than we deem it at present.

Shell small, generally much eroded and weed-covered when alive, sculpture at edges wrinkly and similar to that of *caelata*, greenish; girdle white with black bands; corneous processes at sutures, and a few scattered over the girdle.

Upon dissection valves are more flattened; sutural laminae shorter, green, and widely separated, side slit very short; anterior teeth short; posterior valve broad, callus rounded and well developed. Contrasted with the typical *caelata*, the internal green coloration, which attracted Thiele, is very noticeable; the breadth of the valves, and the shortness of the teeth and sutural laminae being also characteristic, as is the posterior valve.

Dimensions: 16 x 8 mm.

Station: Between tide marks. Type from Lyttelton Harbour, New Zealand. Apparently distributed throughout New Zealand.

42. MAORICHITON MIXTUS.

(Plate vii., figs. 9-12.)

1914. *Plaxiphora (Maorichiton) mixta* Iredale, Proc. Mal. Soc., xi., 33, pl. ii., figs. 12, 15, 16, 18. March. Sunday Island. Kermadec Group. Type in Canterbury Museum, Christchurch, New Zealand.
1915. *Plaxiphora mixta* Oliver, Trans. N.Z. Inst., 47, 1914, 557.

Iredale's description reads: "Shell small, elongate, somewhat elevated; valves keeled and beaked; girdle densely hairy. Coloration generally black, white and green. Some specimens agree most accurately with E. A. Smith's description of his *C. terminalis* as regards coloration; sometimes dark blue, with white markings; rarely rich brown, with white markings; girdle always green. Anterior valve with eight radiating ribs not much elevated, and between each rib wrinkled V-sculpture. Median valves with the lateral area bounded on both sides by strong raised, somewhat nodulous ribs, between which appears a transversely wrinkled or V-sculpture; the pleural areas sculptured, with irregular fine wavy longitudinal ridges more pronounced at the edges, and becoming very fine on the dorsal area. Posterior valve triangular, with the mucro terminal, and the posterior area reduced to raised ribs; the anterior portion sculptured like the pleural areas of the median valves. Inside coloration deep blue-green. Anterior valve with projecting insertion-plate, with grooved, widely spaced somewhat irregular teeth; the slits eight in number. Median valves with projecting insertion-plate with one slit; sutural laminae widely placed apart and whitish in colour, inside as well as out. Posterior valve with no insertion-plate, but a callused semicircular ridge, which is much exceeded by the pointed tegmentum. Girdle densely covered with long hairs, which are somewhat longer and bunched at the pores. Young specimens show the sculpture to be much stronger in the juvenile, the pleural areas of the median valves having well marked and deep longitudinal ridges, and the

lateral areas are bounded by heavy, somewhat nodulous ribs. The majority of adult specimens are covered with marine growths, and the tegmentum is much eroded. Length of type 32, breadth 15 mm. Habitat: Sunday Island, Kermadec Group (type); ? Macauley Island, Kermadec Group. Station: At Sunday Island it was rarely found in crevices of rocks between tide marks. I collected a few specimens in deep rock pools between tides, but I am not satisfied that these are identical with the one here described."

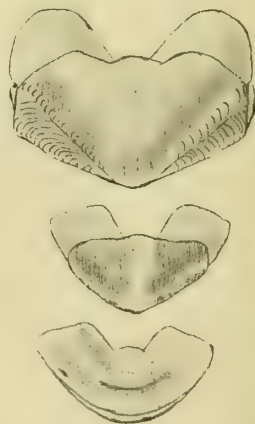
43. MAORICHITON SCHAUINSLANDI.

(Plate vii., fig. 8.)

1909. *Plaxiphora schauinslandi* Thiele, Revision Chitonen, pt. i. (Chun's Zoologica, heft. 56), 28, pl. iii., figs. 41-43. Chatham Islands, New Zealand. Type in Berlin Museum, Germany.
1904. *Chaetopleura hahni* Wissel, Zool. Jahrb. Abt. Syst., 20, 73. Error only of nomination.
1905. *Plaxiphora glauca* Suter, Journ. Malac., xii., 66. Not *P. glauca* auct. of Australia.
1909. *Chaetopleura hahni* Suter, Nachr. Blatt. Deutsch. Mal. Gesell., 600. Correction of Wissel's error.
1913. *Plaxiphora glauca* Suter, Man. N.Z. Moll., 20. Atlas, pl. 3, fig. 13.
1913. *Plaxiphora albida* Suter, Man. N.Z. Moll., 1079. Not *P. albida* auct. of Australia.
1915. *Plaxiphora glauca* Iredale, Trans. N.Z. Inst., 47, 1914, 421.

A curious large form of *Maorichiton* lives at the Chatham Islands, and was first recorded as distinct by Wissel, who named it *Chaetopleura hahni*, a synonym of the South American form of *Plaxiphora aurata*. Then Suter received specimens and recorded them as *Plaxiphora glauca*, an Australian species. As the shells were referable to *Maorichiton*, while the Australian shells belong to *Poneroplax*, the association was obviously incorrect. Thiele did the correct thing and described them as a new species, *Plaxiphora schauinslandi*. The notable features were large size and coarse sculpture, and Iredale, ignoring geographical divisions, suggested their identity with *terminalis* Smith, but the type locality of the latter was Auckland. Consequently, *schauinslandi* must be used for this Chatham Island shell, and it is here regarded as specifically distinct.

The shell is larger than the mainland forms, similarly elongate in shape, sculpture of same form, but much coarser, the wrinkle sculpture standing up as ridges, while the lateral ribs are strong and cut into elongate bars, the anterior valve ribbing similarly striking, the noduling separate. In some cases the



Copy of Thiele's figure of *Plaxiphora schauinslandi*.

shell is smoother, even as on the main land, but even then the sculpture is coarse.

XV. Genus DIAPHOROPLEX.

1914. *Diaphoroplex* Iredale, Proc. Mal. Soc., xi., 32. March. Type by original designation, *Chiton biramosus* Quoy and Gaimard.

This beautiful endemic Neozelanic form may not be referable to this subfamily, but more study will be necessary to determine this point. The study of the megalæsthetes and sections may assist in this direction.

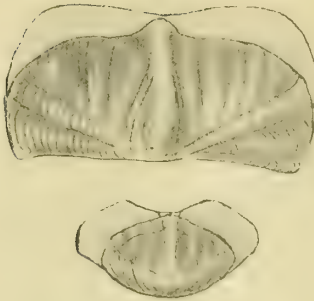
Iredale stated: "The exterior of the valves (which are very solid) is sculptured, whilst the sutural laminae are connected, a feature otherwise quite foreign to the genus (*Plaxiphora* s.l.), and the posterior valve is quite differently formed.

"Superficially, this shell has the appearance of the true *Plaxiphora*, but externally is separated by the complex sculpture, and internally by the continuous sutural laminae and structure. The teeth are fluted and striated throughout, while no fluting nor striation occurs in *Plaxiphora* s.str. at any stage. The posterior valve also shows striation on the callus, which is definitely sinuate medially.

44. DIAPHOROPLEX BIRAMOSA.

(Plate vii., figs. 15, 16.)

- 1835. *Chiton biramosus* Quoy and Gaimard, Voy. de l'Astrol. Zool., iii., 378, pl. 74, figs. 12-16. French Pass, Tasman Bay, N.Z. Type in Paris Museum.
- 1836. *Chiton biramosus* Deshayes, Hist. Anim. s. Vert. (Lam.), Ed. 2, vii., 516.
- 1843. *Chiton biramosus* Gray, Travels in N.Z. (Dieff.), ii., 246.
- 1872. *Tonicia corticata* Hutton, Trans. N.Z. Inst., iv., 1871, 180. Habitat: ?. Type in Colonial Museum, Wellington, N.Z.
- 1872. *Acanthopleura complexa* Hutton, Trans. N.Z. Inst., iv., 1871, 181. Habitat: ?.
- 1872. *Acanthochaetes biramosus* Hutton, Trans. N.Z. Inst., iv., 1871, 181.
- 1873. *Acanthopleura ciliata* Hutton, Cat. Mar. Moll. N.Z., 49 (Pitt's I.).
- 1873. *Acanthochaetes biramosus* Hutton, Cat. Mar. Moll., N.Z., 50 (includes *corticata*).
- 1880. *Plaxiphora biramosa* Hutton, Man. N.Z. Moll., 116.
- 1893. *Plaxiphora biramosa* Pilsbry, Man. Conch., xiv., 39, pl. 68, figs. 51-54.
- 1897. *Plaxiphora biramosa* Suter, Proc. Mal. Soc., ii., 188. July.
- 1904. *Plaxiphora setiger* Wissel, Zool. Jahrb. Abt. Syst., 20, 603. Error only.
- 1904. *Plaxiphora biramosa* Hutton, Index Faunae N.Z., 86.
- 1905. *Plaxiphora biramosa* Hamilton, Col. Mus. Bull., No. 1, 36.
- 1909. *Plaxiphora setiger* (Wissel) Suter, Nachr. Blatt. Malac. Gesell., 1909 (2), 74. Correction.
- 1909. *Plaxiphora biramosa* Thiele, Revision Chitonen, pt. i. (Chun's Zoologica, heft. 56), 26, pl. iii., figs. 37-38.
- 1910. *Plaxiphora biramosa* Iredale, Proc. Mal. Soc., ix., 93 (= *cuprea* Cpr. B.M.).
- 1913. *Plaxiphora biramosa* Suter, Man. Moll. N.Z., 18, 1078. Atlas, pl. 3, fig. 4; pl. 2, fig. 11.
- 1915. *Plaxiphora biramosa* Iredale, Trans. New Zeal. Inst., 47, 1914, 424.
- 1924. *Plaxiphora biramosa* Powell, N.Z. Journ. Sci. Tech., 6, 285.



Copy of Thiele's figure of
Plariphora biramosa
Q. & G. (type).

It is curious that such a glorious Loricata as this is when alive should have a somewhat chequered history. It was well described by Quoy and Gaimard, thus: "Chiton, corpore ovali planiusculo, rubro, duabus seriebus pilis binis cincto, margine villosa; valvis planiusculis, viridi-rubentibus aut albidis, antice transversim striatis.

"Cet oscabrion est ovalaire, allongé, à manteau nu, d'un rouge brun assez vif, entouré de deux rangées écartées de poils rudes, rares et bifurqués. Le premier range touche les osselets, le seconde avoisine le bord du manteau, qui est lui-même villeux, jaunâtre en dessous, ainsi que le pied. Les franges céphaliques, au lieu de s'étaler, se resserrent en long sur les

côtes de la bouche. Les branchies arrivent à les toucher. Il y a de chaque côté, trente-trois folioles, et de plus, en avant, une douzaine d'autres lamelles plus petites. Les valves sont très-transverses, peu élevées, à arc surbaissé, sans carène, un peu cordiformes et striées sur leur limbe en avant, blanches ou verdâtres, avec un cercle rouge brun. La première a neuf dents sur le bord, et la dernière n'en présente aucune. Les apophyses d'insertion sont peu larges, et ne sont séparées que par une échancrure très-obtuse. Elles sont entaillées, comme à l'ordinaire, sur le côté. A l'exception du dernier, tous ces osselets décroissent peu. En dessous ils sont d'un blanc mat. Leur forme extérieure était légèrement altérée en arrière dans les deux individus que nous possédons: mais la couleur rouge de cette espèce et ses deux rangées d'aiguillons binaires la feront facilement distinguer. Elle provient de la Nouvelle-Zélande, et a été prise dans la Passe des Français de la baie Tasman. Dimensions: Longueur, 22 lignes. Largeur environ, 15 lignes."

When Hutton wrote his first memorable account of the Loricates of New Zealand, an account well ahead of those of his contemporaries elsewhere, he introduced:—

"*Tonicia corticata*. Oval; margin naked; valves much depressed; posterior margins slightly concave; lateral areas bounded on either side by a flatly nodulose ridge, the space between being obliquely striated, the striae running outward and backward; median areas rugose, without either distinct lines or granules. Length, 1.25 inch; breadth, 1.13 inch. Colour: Margin black when dry; valves grey; inside white, covered over with white coralline growth, and small marine algae.

"Founded on a specimen in the Colonial Museum; locality not stated."

At the same place Hutton described *Acanthopleura complexa*: "Oval; margin broad, velvety, with long spines scattered over it; valves depressed, flattened on each side, subcarinate; posterior margins not covering the next at the corners, rather convex, and pointed in the centre; anterior valve with radiating moniliform ridges; lateral areas of intermediate plates granulose, with two prominent, radiating, slightly curved ridges on each side; median areas with finely granular transverse waved lines, which pass imperceptibly into the larger lateral granulations; posterior valve small,

like the intermediate ones; centre of valves punctate internally. Length, 1 inch; breadth, .5 inch.

"Colour: Margin reddish brown, varied with darker; valves greyish, more or less varied with yellowish-white, yellow, or brown.

"From the collection of the late Mr. W. Swainson; locality not stated."

Specimens had been collected by the early workers in New Zealand as Captains Bolton and Stokes, and when Carpenter worked at these in the British Museum he determined them as a new species, which he called *Streptochiton cupreus*, but later he regarded them as *caelata* Reeve, and led Smith into the error of describing *Chiton terminalis*.

Hutton, in New Zealand, had identified the species from the French voyages, though the British workers did not do so. Consequently, the species became well known to Neozelanian workers, who, however, on the mainland, appear to have confused *aurata* with it.

xvi. Genus *VAFERICHITON*, nov.

Type *Plaxiphora murdochi* Suter.

The very fine close sculpture and appearance of this shell, together with the remarkable girdle covering, demand a distinctive name. While it shows general Plaxiphorid features in having the anterior valve eight-slit, the median one-slit and the posterior valve with a callus only, the girdle has sutural pores, but is covered with *minute triangular scales, some grooved, some plain*. There are no true corneous processes present, but a few scattered hairs may be detected.

45. *VAFERICHITON MURDOCHI*.

(Plate vii., figs. 13, 14.)

1905. *Plaxiphora* (s.str.) *murdochi* Suter, Journ. Malac., xii., 67, pl. ix., fig. 11. December 30. Kawhia Harbour, North Island, N.Z. Type in Coll. Suter, now in Wanganui Museum, New Zealand.
1913. *Plaxiphora murdochi* Suter, Man. N.Z. Moll., 20. Atlas, pl. 3, fig. 16.
1915. *Plaxiphora murdochi* Iredale, Trans. N.Z. Inst., 47, 1914, 424.

This species was well described by Suter from a locality little visited, viz., Kawhia Harbour, west coast of North Island, New Zealand, and, of course, is little known, as collections have not since been made from that locality as far as we are aware.

Among a collection of Loricates made by C. R. Laws at Tomahawk, on the south coast of the Otago Peninsula, in the South Island, was a remarkably well preserved shell, which recalled no species autoptically known to us. We had a beautiful drawing made, and then a familiarity developed which led us to the figure provided by Murdoch and published by Suter.

Suter's description of his *Plaxiphora* (s.str.) *murdochi* reads: "Shell rather small, oval, slightly narrowed behind, roundly angled along the top of the valves, blackish-green, finely sculptured, intermediate valves mucronated, girdle rather narrow; of a minutely scaly appearance and with sparse hairlets. Anterior valve radiately eight ribbed, with five diverging striae, which are coarser near the anterior margin, and from (sic) elongated nodules on the posterior edges. Intermediate valves with a lighter coloured posterior mucro, the whole surface sculptured with fine striae; the lateral areas are distinctly marked off by an elevated ridge descending from the jugum and dissolving into numerous fine striae near the margins, the striae on the lateral areas and the pleural tracts are arranged in such

a way that they radiate from the ridge like the webs from the shaft of a feather. The posterior margin has a row of nodules on each side, like the anterior valve. Central area with diverging riblets in front of the mucro, but straight and parallel to the jugum on the remaining surface. Posterior valve small, very slightly emarginate behind; mucro terminal, slightly raised, from the elevated postero-lateral ribs; the fine riblets diverge straight in front, obliquely on the posterior side. Girdle has, viewed with an ordinary pocket lens, the appearance of being minutely scaly, but a more powerful lens reveals the fact that the whole girdle is densely and regularly pitted. Near some of the sutures I found tufts of a few light coloured bristles, and a few hairlets were found near the margin of the girdle, but it was not easy to find them. It seems most likely that the whole girdle was originally densely covered with fine, short hairlets, and tufts near all the sutures, but that they are very easily rubbed off. Colour blackish-green, girdle a little darker. The anterior valve has a few concentric zigzag bands of light blue; the intermediate valves have a number of wavy, longitudinal blue streaks, running over the lateral and pleural tracts; the posterior valve has only an indistinct blue patch on each side. Interior blue, the sutural laminae white. Sinus rather narrow, straight; the sutural laminae broadly arched, short. Anterior valve with eight slits, corresponding to the external ribs: teeth strong, broadly grooved on the outside; intermediate valves with one slit on each side, corresponding with the ribs of the lateral areas; posterior valve with a smooth insertion-plate, with a posterior median sinus, no slits. Length, 17; breadth, 13 mm.; divergence, 108° . Habitat: Near entrance to Kawhia Harbour; on rocks at half tide. Much exposed to very heavy seas. With regard to the sculpture this species stands nearest to *P. biramosa* and *caelata*, but in both of these it is much coarser. The beautiful fine sculpture, colour, and the curiously pitted girdle, when devoid of hairs, separate it at once from the two."

Judging from the densely packed scales on the girdle of the example collected by Laws, it would appear that Suter's type had been stripped of its scales—hence the "curiously pitted girdle."

Laws's specimen was collected on rocks at half tide.

xvii. Genus GUILDINGIA.

1893. *Guildingia* Pilsbry, Man. Conch., xiv., 329. ex Carpenter MS. Type by original designation *Plaxiphora obtecta* Pilsbry.
 1878. *Guildingia* Dall, Proc. U.S. Nat. Mus. (Sci. Res. Expl. Alaska), 332, ex Cpr. M.S. *Nomen nudum*.
 1881. *Guildingia* Dall, Proc. U.S. Nat. Mus., 284, 288. *Nomen nudum*.

This very beautiful monotypic genus is so unlike the rest of the Plaxiphorids as to suggest another location, but further research is necessary to determine this.

Shell large, oval, smooth and glossy; girdle very large, fleshy and thickly beset with long corneous processes. The teeth are very long in the anterior and median valves, the sutural laminae long, a deep sinus between, in the posterior valve, which has the mucro of the tegmentum terminal. The complete lack of sculpture, save for growth lines, combined with the comparative narrowness of the valves and the great width of the girdle sufficiently characterise this genus.

The genus name was proposed by Carpenter, but never characterised, and Dall twice mentioned it without validating it, so that the name was still a *nomen indet.* until Pilsbry defined it. Nevertheless, an apparent contradiction must be explained.

Tryon in his Struct. and Syst. Conch., Vol. ii., 1883, 345, wrote:—

"*Euplaciphora*, Shutt. Sinus wide, planate; girdle set with bristles, not fasciculated.

"*Guildingia*, Cpr. Valves partly immersed; girdle emarginate behind. *C. petholatus*, Sowb. (lxxxvi., 89)."

Reference to the plate shows a figure of "*petholatus*," agreeing with the diagnosis of *Euplaciphora*, not of *Guildingia*, and in the explanation of plates, p. 427, appears:—

"Pl. 86, fig. 89. *Chiton (Euplaciphora) petholatus* Sowb. Australia. Page 345."

This proves that the citation of *petholatus* under *Guildingia* was merely a printer's error, and that it should have been placed after *Euplaciphora*.

46. GUILDINGIA OBTECTA.

(Plate vii., figs. 17-23.)

- 1893. *Plaxiphora oblecta* Pilsbry, Man. Conch., Ser. 1, xiv., 330 (June). ex Carpenter MS. New Zealand. Type in Mus. Cuming in British Museum.
- 1894. *Plaxiphora suteri* Pilsbry, Nautilus, viii., 8. Timaru, Sumner and Port Lyttelton, N.Z. Type in Philadelphia Acad. Nat. Sciences.
- 1897. *Plaxiphora suteri* Suter, Proc. Mal. Soc., ii., 190.
- 1897. *Plaxiphora (Guildingia) oblecta* Suter, Proc. Mal. Soc., ii., 192.
- 1904. *Plaxiphora suteri* Hutton, Index Faunae N.Z., 87.
- 1904. *Plaxiphora oblecta* Hutton, Index Faunae N.Z., 87.
- 1904. *Plaxiphora glauca* Wissel, Zool. Jahrb. Abt. Syst., 20, 606. Erroneous identification only.
- 1905. *Plaxiphora suteri* Hamilton, Col. Mus. Bull. No. 1, 41.
- 1905. *Plaxiphora suteri* Nierstrasz, Notes Leyden Mus., xxv., 149.
- 1909. *Plaxiphora glauca* Suter, Nachr. Blatt. Deutsch. Mal. Gesell., 74. Correction of Wissel's error.
- 1909. *Plaxiphora oblecta* Suter, Nachr. Blatt. Deutsch. Mal. Gesell., 74. (= *suteri* Pilsbry).
- 1910. *Plaxiphora oblecta* Iredale, Proc. Mal. Soc., ix., 92. July.
- 1913. *Plaxiphora oblecta* Suter, Man. N.Z. Moll., 23, 1077, 1079. Atlas, pl. 2, fig. 7; pl. 32, fig. 10.
- 1915. *Guildingia oblecta* Iredale, Trans. N.Z. Inst., 47, 1914, 425.

Pilsbry published as *Plaxiphora oblecta* a description of a specimen in the British Museum which Carpenter had regarded as a distinct genus *Guildingia*. The description reads: "Shell large, broad, partly covered. Valves smooth, most minutely punctulate angulate in front; sutural sinus large, produced forward over the jugum; lateral areas scarcely defined, except by an angle at the forward outer margin of the valves; dorsal ridge rounded. Intense olivaceous, paler on the dorsal ridge. Mucro of posterior valve terminal hardly produced. Interior; posterior valve with flattened insertion-plates. Anterior valve with eight; central valves one-slit; teeth very acute, long, smooth, a little thickened at the slit-edges; eaves narrow, spongy. Sinus deep, very obtusely angular, with a spongy area. Sutural laminae long, separated. Girdle very broad, sinuated behind, with bundles of about three large, horn-like hairs at the sutures and having smaller ones sparsely scattered all over more or less closely (Cpr.). Length, 50;

breadth, 32 mm.; divergence, 120 mm. New Zealand (Mus. Cum., No. 45). This very interesting shell differs from the typical *Plaxiphorae* as *Fannettia* does from *Tonicia*. It is, however, simply an exaggeration of *P. terminalis*."

Lack of illustration apparently led to this erroneous conclusion by Pilsbry, so that almost immediately he described (from specimens) *Plaxiphora suteri* thus: "Shell resembling *P. biramosa* Q. and *P. superba* Cpr.; but girdle all over sparsely (*sic*) hairy, *without the least indication of pores or sutural bristles*. Valves smooth, with slight growth-wrinkles, the diagonal rib but slightly indicated. Ridge with a chestnut band with a stripe of green on each side of it, the pleura and lateral areas uniform blackish olive. Girdle blackish with chestnut hairs. Interior blue, fading to white on the sutural-plates. Length, about 45; breadth, about 25 mm. (specimens all curled and contracted) Timaru, Sumner and Port Lyttelton, S. Island, N.Z. (H. Suter). A young specimen has the earlier formed portion of each valve light brown, spotted with white. This is probably the normal colouring of the young shells."

Dimensions: Up to 90 x 60 mm.

This fine shell lives commonly on the rocks at low water among kelp roots, and Iredale co-ordinated the two descriptions, but Suter at first demurred. Later, Iredale examined the type of *oblecta*, and Suter agreed to the identity, which cannot be questioned.

xviii. Genus FREMBLEYA.

1866. *Frembleya* H. Adams, P.Z.S., 445. Type by monotypy *F. egregia* H. Adams.

1878. *Streptochiton* Dall, P.U.S. Nat. Mus., 1878, 332, as synonym of *Frembleya* (*sic*).

The original diagnosis reads: "Testa ovalis, convexa. Valvae transversae, latae, carinatae; apex posterioris; valvae terminalis, producta, fissa. Limbus angustus, postice fissus, setis corneis, dense obsitus.

"The covering of the mantle, the form of the visible portions of the valves, and the peculiarity of the terminal valve, render this species distinct from any form of CHITONIDAE yet described. It has the appearance of a *Lorica*, with the mantle covered with long bristles, instead of imbricate scales."

This is another of the remarkable Neozelanic forms classed in the PLAXIPHORIDAE for want of a better location. It is practically certain that later research will remove this genus elsewhere.

Shell elongate, oval to broadly ovate, heavily sculptured; girdle comparatively narrow, sutural tufts prominent, similar tufts in front of the anterior valve probably eight in number, while three or four may be found behind the posterior valve where the girdle is sinuate. The valves are very wide and somewhat shallow; the sutural laminae wide and the teeth short. In the anterior valve the slits are eight in number, the teeth grooved, the edges fluted; in the posterior valve the plate is reduced to a callus beyond which the mucro of the tegmentum projects. This mucro is upturned, and a receding slope can be distinguished behind.

This species (for the genus is at present monotypic) lives inside kelp roots at low tide, and when alive the animal is very fleshy; the gills are distant, though extending the length of the foot.

47. *FREMBLEYA EGREGIA*.

(Plate viii., figs. 1-8.)

1866. *Frembleya egregia* H. Adams, P.Z.S., 1861, 445, pl. xxxviii., fig. 9.
Hab. ? = New Zealand. Type in British Museum.
1872. *Acanthochaetes ovatus* Hutton, Trans. New Zeal. Inst., iv., 1871, 182.
Hab.: New Zealand. Type in Dominion Museum, Wellington, N.Z.
1873. *Acanthochaetes ovatus* Hutton, Cat. Marine Moll. N.Z., 50.
1880. *Acanthochites ovatus* Hutton, Man. N.Z. Moll., 117.
1893. *Plaxiphora egregia* Pilsbry, Man. Conch., xiv., 331, pl. 65, figs. 80, 81, 82.
1893. *Streptochiton tortuosus* Pilsbry, Man. Conch., xiv., 331, ex Carpenter MS. in synonymy.
1893. *Plaxiphora ovata* Pilsbry, Man. Conch., xiv., 332, pl. 54, figs. 34-40.
1897. *Plaxiphora (Fremblya) ovata* Suter, Proc. Mal. Soc., ii., 192.
1904. *Plaxiphora ovata* Hutton, Index Faunae N.Z., 87.
1905. *Plaxiphora ovata* Hamilton, Col. Mus. Bull. No. 1, 36.
1908. *Plaxiphora ovata* Iredale, Trans. N.Z. Inst., xl., 1907, 375; pl. xxxi., fig. 1 (six-valved aberration).
1909. *Frembleya ovata* Thiele, Revision Chitonon, pt. i. (Chun's Zoologica, heft. 56), 29, pl. iii., figs. 50-2.
1910. *Plaxiphora egregia* Iredale, Proc. Mal. Soc., ix., 92.
1913. *Plaxiphora ovata* Suter, Man. N.Z. Moll., 24. Atlas, pl. 2, fig. 8; pl. 3, fig. 15.
1913. *Plaxiphora egregia* Suter, Man. N.Z. Moll., 1079.
1915. *Plaxiphora egregia* Iredale, Trans. N.Z. Inst., 47, 1914, 424.
1926. *Plaxiphora ovata* Mestayer, Trans. N.Z. Inst., 56, 585, pl. 100, figs. 7-8 (type figured).

H. Adams's description of the species reads: "Shell ovate, a little narrower in front, green-brown, paler at the sides. Anterior valve radially ribbed, the ribs pustulose, interstices obliquely liriate; posterior valve and median valves subcarinate, the dorsal areas densely longitudinally liriate; lateral areas radially ribbed, the ribs pustulose. Girdle moderate, furnished with short, corneous spicules.

"Habitat unknown."

A few years later Hutton described *Acanthochaetes ovatus*: "Ovate, attenuated in front; margin spiny, with nine small bundles along each side; valves flatly triangular, sub-carinate, posterior valve very narrow, apex re-curved; posterior margins of the anterior plate sloping backwards into a point, those of the posterior plates nearly straight, anterior valve with ten, and lateral areas with two on each side, radiating nodulose ridges; median areas with slightly waved longitudinal ridges; dorsal line smooth. Length, .6 inch; breadth, .5 inch.

"Colour: Mantle pale reddish brown; spines white; valves greenish white; yellowish on the dorsal line. Several specimens in the Colonial Museum; locality not stated."

Pilsbry published Carpenter's MS. description of the type of *egregia* and associated *ovata* in the same group, but did not accept their identity. The description reads: "Shell olivaceous, maculated with more or less intense; ovate, broad, elevated; dorsal ridge rather acute, much elevated, the side slopes straight. Valves strongly beaked, each one eroded in front from the attrition of the next valve forward. The central areas have about 16 lirae on each side, about equalling the interspaces in width.

Lateral areas elevated, bicostate, the ribs strongly granose, granules larger at the sutures, intermediate space obliquely costate or V-costate. Anterior valve having 10 radiating ribs, the interstices sculptured with V-shaped sulci, the V's meeting over the ribs and rendering them somewhat nodulous. Posterior valve with posterior elevated mucro and a single posterior rib on each side; posterior area very narrow and smooth. The girdle has soft hairs, and a few larger, and there is some trace of pores. The posterior slit in the girdle mentioned by Adams seems to be an accidental tear; H. Adams believes the same. Length, 15; breadth, 10 mm.; divergence, 133° ."

As the habitat was unknown, Pilsbry added: "Newcastle, Australia (Dieffenbach, teste Cpr.)," and through this erroneous locality the two species were kept separate. Dieffenbach collected in New Zealand, and a mistake in locality was made, as the form is restricted to New Zealand. Recently, Miss Mestayer has figured the type of *ovata* Hutton and advocated two species, but the variation observed is purely individual.

Station: Up to the present only found under kelp roots at low tide.

Dimensions: Up to 20 x 14 mm.

xix. Genus HEMIARTHURUM.

1876. *Hemiarthrum* Dall, Bull. U.S. Nat. Mus., iii., 44. February. ex Carpenter MS. Type by monotypy *H. setulosum* Dall.

At the place cited Dall published Carpenter's MS. account without comment. In that description Carpenter concluded that it formed a transition between *Hanleya* and the articulate chitons through the value of the insertion-plates. Haddon did not add anything of value in his account of the Kerguelen species, consequently Pilsbry allowed the species the same location, i.e., in the LEPIDOPLEURIDAE.

Obviously it had no real relation with the majority of the species, and examination of specimens collected at Macquarie Island suggested their reference here. We wrote (this Journal iii., 339, 1925) that "*Hemiarthrum* proves to be a *Plaxiphora*, with the anterior and median valves showing unslit insertion-plates and degenerate external sculpture."

Finlay printed Iredale's note (Trans. N.Z. Inst., 57, 1927, 333): "*Hemiarthrum* may be a degenerate *Plaxiphorida*, the unslit head plate being faintly striated, the sutural laminae of the median valves being more like those of *Plaxiphora s.l.* than of *Acanthochiton s.l.*, while the little unslit projecting tail plate is like that of a young *Plaxiphorida*, and not at all *Acanthochitonoid*. Further, the sculpture agrees better with that of the former, and, curiously enough, while Carpenter noted only four tufts around the head valve—the correct number for an *Acanthochiton*—Haddon pointed out that the specimen he examined had six, while the specimens in the Australian Museum prove to have eight, which pretty definitely determines the relationship."

Shell small, elongate, valves weakly sculptured; girdle leathery, with short corneous processes scattered all over, and bunches of longer processes at sutural pores, and also eight in front of anterior valve and two behind the posterior valve.

Internally, the anterior valve shows a weakly striated insertion-plate, with vestiges of slits indicating its degenerate nature; median valves with sutural laminae fairly widely separated and extending at sides without any slit. Posterior valve with sutural laminae of the typical *Plaxiphorida* form, and a sinuate callus of similar design, the tegmentum exceeding it. These characters are very different from any of the true *Lepidopleurids* or *Acanthochitonoids*.

48. *HEMIARTHURUM HAMILTONORUM*, *sp. nov.*

(Plate viii., figs. 9-15.)

1916. *Hemiarthrum setulosum* Hedley, Austr. Antarctic Exped., 1911-1914, Sci. Rep. Ser. C. Zool., Vol. iv., 34. Macquarie I.
 1926. *Hemiarthrum setulosum* Finlay, Trans. N.Z. Inst., 57, 332.
 [Not *Hemiarthrum setulosum* Dall, Bull. U.S. Nat. Mus., iii., 44 (February), ex Cpr. MS. Kerguelen I.]

Finlay published Iredale's note: "The Macquarie Island shells appear to be a little different, the sculpture being finer and the mucro of the posterior valve nearly median and a little elevated, while in the extra-limital shell the mucro is elevated and terminal."

The generic description covers this species, and the detail figures show all the points emphasised, the mucro, however, being shown more posterior than usual. The species is named for the two Hamiltons, father and son, who both collected on the Subantarctic Islands.

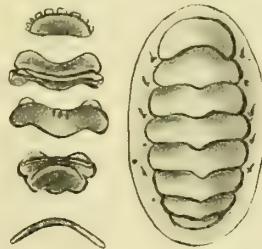
Dimensions: 10 x 5 mm.

Station: On rocks washed by the sea at low water.

[49. *MOPALIA AUSTRALIS*.

1907. *Mopalia australis* Suter, Proc. Mal. Soc., vii., 215, pl. xviii., fig. 12a. Snares I., New Zealand. Type in Coll. Suter now in the Wanganui Museum.
 1909. *Mopalia australis* Suter, Subant. Islands of N.Z., i., 2.
 1913. *Mopalia australis* Suter, Man. N.Z. Moll., 16. Atlas, pl. 3, figs. 12, 12a.
 1915. *Acanthochiton australis* Iredale, Trans. N.Z. Inst., 47, 1914, 420, 425.
 1926. *Mopalia australis* Ashby, Proc. Mal. Soc., xvii., 32 (nothing).

Suter described a curious little shell thus: "Shell very small, elongately oval, with a blackish leathery girdle and sutural tufts. Anterior valve with eight slits, teeth smooth. Intermediate valves with a rounded central posterior projection; insertion-plates with one slit. Posterior valve depressed, with an oblique slit on each side, and bisinuate in the middle behind. Girdle narrow, leathery, slightly broader on the sides, with a few sutural spicules. Colour probably ash-grey, with a few longitudinal brown stripes on the jugum; inside bluish grey with a posterior brown margin. On the intermediate valves the tegmentum forms a narrow band by passing beyond the articulamentum. Sinus broad and slightly pectinate, the sutural plates narrowly rounded. The valve callus is quite distinct. Length, 9; breadth, 5.5 mm.; divergence, 120°. Habitat: I am indebted to Captain J. Bollons for two specimens he collected at the Snares Islands (south of Stewart Island). Both examples are so much corroded that it is impossible to recognise the sculpture. The side slits of the posterior valve leave no doubt about its generic position."



Copy of Suter's figures of
Mopalia australis.

Iredale suggested that this might be an *Acanthochiton*, as the posterior valve is two slit and somewhat sinuate behind, while the eight slits might

have been due to interslitting. Ashby's remarks are entirely valueless, thus: "The few setae mentioned by Suter as occurring on the girdle are probably mopalioid" is entirely imaginary, as Suter's description copied above shows. At present it cannot be exactly determined.]

VIII. Family CHITONIDAE.

All the most specialised forms of Loricates with scaly girdles and pectinate teeth have been classed, together with similar forms without girdle scales, in the family CHITONIDAE, which is undoubtedly composed of diverse elements.

In Neozelanic waters there are three very distinct series with scaly girdles, the *Tegulaplex-Rhyssoplax-Mucrosquama* series, the *Sypharochiton* series, and the *Amaurochiton* series, and one with a leathery girdle, *Onithochiton*.

As these series have geographic ranges of distinct evolution, it will be as well to name the series as subfamilies at once and place them on a systematic basis.

The subfamily *Rhyssoplacinae* comprises species ranging from the Mediterranean Sea, through the Red Sea, Indian Ocean, Australia, and New Zealand to the Pacific Ocean. Curiously enough, the majority of species live in southern Australia and New Zealand, where they also grow to their largest size. They have a very characteristic external appearance, shape, sculpture and girdle scaling, and internally they are just as well-marked, the insertion-plates being long, regular, well cut, teeth and sinus finely denticulate. The slitting in the anterior valve is eight, the median valves one-slit on each side, the posterior valve 10-12 slit, mucro submedian. There is so little variation in this respect that no features of value can be utilised for separative purposes. The scales vary a little in size and striation. They generally live below half tide to below low water, but none have yet been dredged from any depth. All are fairly active; the genus *Tegulaplex* is very active, while the *Mucrosquama* (an Australian genus) series tend to become sedentary at an early stage. Only two genera occur in this region: *Tegulaplex*, with concentric sculpture on the anterior valve and lateral areas of the median valves, restricted to Lord Howe Island at present, and *Rhyssoplax*, with the lateral areas and anterior valve radiately ribbed; in Australia a section of *Rhyssoplax* has the anterior valve and lateral areas smooth, a phase passed through in youth by the Neozelanic shells.

The subfamily *Amaurochitoninae* contains two species—one in South America, the other in New Zealand; it only occurs in Australia as an established introduced shell. The curious sculpture and extraordinary girdle scales indicate this subfamily at sight.

The subfamily *Sypharochitoninae* includes species of heavy build, coarse external sculpture (though sometimes obsolete) and large separate scales. Internally, the teething of the insertion-plates is very unlike that of the other subfamilies, being rough and brittle.

The genus *Onithochiton* is notable for very pronounced "eyes," and consequently anomalous when contrasted with the preceding, as the wide girdle is not scaly, but minutely spiculate, and while the insertion-plates and slits recall those of the *Rhyssoplacinae*, the posterior valve has lost its insertion-plate, a callus being present. One species is very common in New Zealand and a close relative lives at the Kermadecs, but the Lord Howe Island species is like the Australian one, which does not range far south of Sydney, but goes into Queensland, where it becomes associated with

Lucilina, a genus only separable by the fact that the posterior valve has a large elevated mucro and strong well toothed insertion-plate. Resembling these, the genus *Tonicia* occurs in South America, where no *Onithochiton* has yet been found. In view of the discontinuous range, it will be best to call the Austral-Neozelanic subfamily, the *Onithochitoninae*. It may be noted that the genus *Lucilina* occurs in small forms at the Kermadecs and Lord Howe Islands, but valves have as yet only been recovered from dredgings.

XX. Genus TEGULAPLAX.

1926. *Tegulaplast* Iredale & Hull, Aust. Zool., iv., 171. Type by original designation, *Chiton howensis* Hedley & Hull.

The original account is here repeated as we have nothing yet to add: "This curious genus recalls *Rhyssoplax*, but the animal is alert and active like that of *Ischnochiton* (*sensu lato*). The elongate shape with the narrow elevated shell and very broad girdle and characteristic sculpture present features easily recognised. It would appear to be an early offshoot from the ancestral *Rhyssoplacid* stock, which developed a curious sculpture, and has retained it without modification for a long period."

The known distribution of the genus at present is Red Sea, Maldives and Laccadive Archipelagoes, Ceylon, Moluccas, Torres Strait and Lord Howe Island.

50. TEGULAPLAX HOWENSIS.

(Plate viii., figs. 17-24.)

1912. *Chiton howensis* Hedley & Hull, Proc. Linn. Soc. N.S.W., xxxvii., 278, pl. xiii., figs. 7a-g. Lord Howe Island. Type in Australian Museum, Sydney.

This beautiful shell was thus described: "Shell strongly elevated, carinated, side slopes curved and steep. Colour very variable, creamy white, maculated with pink, purple or brown, chiefly on the end valves and lateral areas; central areas green, jugal tract paler, the whole shell finely mottled in colour. Anterior valve with 8-10 somewhat irregular wavy concentric riblets. Posterior valve; mucro prominent, in front of the centre, posterior slope convex, concentrically ribbed similarly to the anterior valve, but with slight radial depressions. Median valves strongly raised, deeply transversely ribbed with irregular wavy riblets which are traversed by a shallow depression. Central areas smooth; jugal tract finely transversely striate. Girdle irregularly tessellated with broad bands of purple brown, with scattered deep green scales. Scales small, densely imbricating, striate, polished on the margins. Interior bluish white; sinus broad, denticulate. Anterior valve having 10, median valves 1-1, and posterior valve 12 slits. Teeth very finely pectinate on the edge. Length, 18 mm.; breadth, 9 mm. Station: On the underside or at the edge of insertion in the sand of small smooth stones, in sheltered pools, at low tide. Habitat: Lord Howe Island. Remarks: It is not closely allied to any other Australasian chiton."

XXI. Genus RHYSSOPLAX.

1893. *Rhyssoplax* Thiele, Das Gebiss der Schnecken (Troschel), ii., 368. Type by monotypy *Rhyssoplax janetrensis* Thiele = *Chiton affinis* Issel.

1893. *Clathropleura* Thiele, Das Gebiss der Schnecken (Troschel), ii., 367. Not *Clathropleura* Tiberi, 1877 (Cf. Iredale, Proc. Mal. Soc., xi., 40, 1914).

1893. *Anthochiton* Thiele, Das Gebiss der Schnecken (Troschel), ii., 377.
Type by monotypy *Chiton tulipa* Quoy & Gaimard.

Medium sized Loricates with scaly girdles, anterior valve with eight slits, median with one slit at each side, posterior valve with about ten slits, all teeth finely denticulate; sutural laminae large, sinus narrow and denticulate. External sculpture generally of radials, more or less nodulose, ribs on anterior valves, median lateral areas and postmucronal area; pleural areas generally longitudinally grooved; the juveniles are smooth and some forms exist in which radials are not developed. Girdle scales oval, striate.

The species live below median tide and are comparatively restricted in distribution, so that many species have developed. The Neozelanic Region may yet receive notable additions, as some half dozen distinct species are now known. Their separative features may be tabulated thus:—

Anterior valve with few rounded nodulose rays.	
pleural areas with few ridges	<i>clavata</i> .
with many nodulose ribs and many ridges on pleural areas ..	<i>huttoni</i> .
Anterior valve with ribs nearly smooth.	
few ridges crossing the pleura	<i>suteri</i> .
few ridges not crossing the pleura	<i>aerea</i> .
many ridges not crossing the pleura	<i>exasperata</i> .
scales larger, sulci stronger	<i>coryphea</i> .
many ridges crossing the pleura	<i>canaliculata</i> .
Anterior valve with ribs cut into lozenges.	
many ridges crossing the pleura	<i>stangeri</i> .
[few ridges, most crossing the pleura	<i>whitleyi</i> .]

51. RHYSSOPLAX CLAVATA.

1907. *Chiton clavatus* Suter, Proc. Mal. Soc., vii., 296, fig. 3 in text. Near Auckland, N.Z. Type in Coll. Suter, now in Wanganui Museum, N.Z.
1913. *Chiton clavatus* Suter, Man. N.Z. Moll., 38. Atlas, pl. 4, fig. 11.
1915. *Rhyssoplax clavata* Iredale, Trans. N.Z. Inst., 47, 1914, 426.

Little is known of this species save Suter's description: "Shell small, elongated oval, acutely raised, surface of all valves minutely shagreened, with nodulous sculpture, colour grey, some valves brown. Anterior valve with eight radiate ribs, each consisting of three flatly convex nodules, the uppermost small and round, the following large and squarish, the lowest a little smaller and oblong; posterior margin crenulate. Intermediate valves have the first longer than the others, sharply angled, and slightly beaked; central areas with five to six deep longitudinal furrows on each side; lateral areas raised, with an anterior and posterior broad rib bearing flatly raised, squarish nodules, which are more numerous on the posterior rib; seventh valve having a few central nodules on the lateral areas marking a third rib; sutures strongly and bluntly crenulated. Posterior valve with two concentric rows of round nodules, representing 10 radiate ribs; mucro slightly in front of the middle, small and pointed, posterior slope straight. Girdle with rather large imbricating, convex, and smooth scales, smaller



Copy of Suter's figure
of *Rhyssoplax clavata*

on the inner side. Colour of valves 1, 2, 7, 8 ash-grey, the other valves greyish brown with white spots along the ridge; girdle uniformly grey. Interior; anterior valve with eight, intermediate valves with one, and posterior valve with 11 slits; teeth pectinate. Length, 14; breadth, 9 mm.; divergence, 95°. Habitat: Rangitoto Island, near Auckland, between tide marks (H.S.). Of the New Zealand species, *C. limans* Sykes, is the nearest, from which, however, it is easily separated by the smooth, not sharply raised tubercles, and the rounded, not pointed, and smooth scales. Only one specimen was found."

52. RHYSSOPLAX SUTERI.

(Plate viii., figs. 28, 29.)

1910. *Chiton suteri* Iredale, Proc. Malac. Soc., ix., 102. June. New name for *Chiton stangeri* Suter, 1897, not Reeve. Lyttelton Harbour, N.Z.
 1897. *Chiton stangeri* Suter, Proc. Mal. Soc., ii., 196. July.
 1904. *Chiton stangeri* Hutton, Index Faunae N.Z., 86.
 1913. *Chiton stangeri* Suter, Man. N.Z. Moll., 40.
 1913. *Chiton suteri* Suter, Man. N.Z. Moll., 1081. Atlas, pl. 2, fig. 19; pl. 4, fig. 13.
 1914. *Chiton suteri* Iredale, Proc. Mal. Soc., xi., 43. March.
 1915. *Rhyssoplax suteri* Iredale, Trans. N.Z. Inst., 47, 426, 1914.
 [1924. *Rhyssoplax suteri* Odhner, Vidensk. Medd. Dansk. Nat. Foren. Bd., 77 (N.Z. Moll.), 9.]

Suter recorded as *Chiton stangeri* a species thus: "In size, shape, coloration, and sculpture very much like *Chiton limans*, but differing in the following points:—The ribs have no *acute*, *elevated* grains, but are flattened. The tail valve has very distinct, flatly nodulous ribs. The jugum is less acute, divergence 120°. The imbricating scales of the girdle are very small on both margins, larger in the middle, *not mucronated*, and very faintly striated, the striae being visible only under strong magnifying power. Length, 13; breadth, 8 mm."

A complete description was published in the Manual: "Shell small, ovate-oblong, elevated, sculpture rather coarse, whitish with green. Anterior valve with about 20 radiate nodulous ribs, apex smooth, microscopically shagreened, sinuated. Intermediate valves sharply angled, side slopes straight; central areas with the jugum smooth and shining, minutely shagreened; sides with six to eight longitudinal grooves on each side, very narrow near the middle, broader towards the margins, ribs broad and smooth; lateral areas with three to four broad radiate ribs, cut up by regular growth-lines into squarish nodules. Posterior valve with about 20 nodulous riblets, central areas smooth, a few grooves on each side; mucro in front of the middle, pointed, posterior slope concave. Girdle with imbricating, rounded, and convex scales, largest in the median rows, microscopically faintly striated. Colour yellowish-white, tessellated with green and grey spots; girdle banded with light blue, green, and white. Interior greyish-blue; sinus narrow, denticulate; sutural laminae broadly rounded, white. Length, 13 mm.; breadth, 8 mm.; divergence, 120°."

Iredale with W. R. Oliver collected two specimens, one at Taylor's Mistake, the other in Lyttelton Harbour, which were determined by Suter as his *C. stangeri*. Iredale later compared them with the type of *C. stangeri* Reeve, in the British Museum, and found them very distinct, Reeve's species being apparently *C. canaliculatus* Quoy & Gaimard. Iredale therefore re-

named Suter's *C. stangeri* as above described, *C. suteri*, adding from his own shells: "The pleural areas are sculptured with six sulci, widely spaced and extending right across; the dorsal ridge quite smooth. The valves are beaked. The sulci of *suteri* are perfectly straight, and much fewer than in a *canaliculatus* of the same size.

53. RHYSSOPLAX AEREA.

(Plate viii., figs. 25-27.)

1847. *Chiton aereus* Reeve, Conch. Icon., iv., *Chiton*, pl. vii., sp. and fig. 36. February. New Zealand. Type in Museum Cuming, now in British Museum.
1873. *Chiton aereus* Hutton, Cat. Marine Moll. N.Z., 48.
1874. *Chiton (Leptochiton) aereus* Smith, Zool. Voy. Erebus Moll., 4, pl. i., fig. 9. Type figured.
1880. *Chiton aereus* Hutton, Man. N.Z. Moll., 112.
1891. *Chiton sciculoides* E. A. Smith, P.Z.S., 392, ex Carpenter MS., as synonymy of *C. aereus*.
1893. *Chiton aereus* Pilsbry, Man. Conch., xiv., 179, pl. 36, figs. 96-97 (copy of Reeve only).
1893. *Chiton sciculoides* Pilsbry, Man. Conch., xiv., 179, ex Carpenter MS. in synonymy.
1897. *Chiton aereus* Suter, Proc. Mal. Soc., ii., 195; synonymy only, not specimens.
1904. *Chiton aereus* Hutton, Index Faunae N.Z., 86.
1905. *Chiton aereus* Suter, Journ. Malac., xii., 70 (correction of 1897 error) record of N.Z. specimens.
1908. *Chiton aereus* Iredale, Trans. N.Z. Inst., xl., 1907, 376 (colour variation, etc.).
1909. *Chiton aereus* Suter, Subant. Islds. N.Z., Vol. i., 4. Auckland I.
1913. *Chiton aereus* Suter, Man. N.Z. Moll., 36. Atlas, pl. 2, fig. 15; pl. 4, fig. 9.
1914. *Chiton aereus* Iredale, Proc. Mal. Soc., xi., 40 (growth stages).
1915. *Rhyssoplax aerea* Iredale, Trans. N.Z. Inst., 47, 1914, 426.
1921. *Rhyssoplax oliveri* Mestayer, Trans. N.Z. Inst., liii., 1920, 179, pl. 38, figs. 9-11. Lyall Bay, N.Z.
1924. *Rhyssoplax aerea* Odhner, Vidensk. Medd. Dans K. Nat. Fören. Bd., 77 (N.Z. Moll.), 9. Auckland I.
1926. *Rhyssoplax oliveri* Finlay, Trans. N.Z. Inst., 59, 334 (is *aerea* juv.).

Reeve's description is very brief: "Shell oblong-ovate, angularly raised in the middle, valves rudely impressly striated throughout, umbonal eminence smooth; dull green; ligament granosely coriaceous. Habitat: New Zealand; Earl. Very characteristic in appearance, though simple in detail; the colour is an uniform dull green, except along the rubbed umbonal summit, where it has a copperas hue."

In 1893, Pilsbry doubted its Neozelanic habitat, but gave Carpenter's MS. notes on the type, as follows: "Central areas having about 20 furrows on each side, not deep, continuing until they are rubbed off in the middle; lateral areas having 4-8 divaricating riblets, much worn, broken up by the concentric rugae of growth; crenate at the sutures; end valves with about 30 riblets. Mucro in front of the middle, posterior slope concave. Interior bluish, sinus with 5-13 denticles, deep, narrow; girdle scales stout, roundish. Length, 39 mm.; breadth, 23 mm.; divergence, 94°."

Four years later Suter recorded its recognition from Manukau Harbour, and, though this was a mistaken identity, Murdoch soon after rediscovered it at Cape Egmont, Miss Mestayer at Lyall Bay, and Suter himself in the Hauraki Gulf.

Then Iredale and W. R. Oliver found it not uncommon in Lyttelton Harbour, and common at Shag Point, Otago, and all round the Otago Peninsula. Colour variations were recorded as follows: "The normal colouring is a bluish-green, sometimes with the girdle marked with white. Yellow-green occurs in some localities; pure lemon-yellow, yellowish-white, pure white, puce-coloured, and bright red-brown specimens are also rarely met with. In Otago, however, shells occur which I call albinos. So far I have obtained five distinct types. The general appearance of the shell is white; first, in which the whole is splashed with greenish-black; then, the valves are pure white, with the girdle blackish-brown; next, the shell is pure white with a greenish tinge, the girdle green and white; a fourth has the valves speckled with green and suffused with yellow, the girdle green and white; lastly, the valves suffused with greenish and the girdle pink."

Later, Iredale recorded: "I examined a series of *Chiton aereus* Reeve, and found that the most juvenile specimens were unsculptured, then the sulcations on the pleural areas appeared before the lateral radial ribbing was formed."

Notwithstanding this, Miss Mestayer has described *Rhyssoplax oliveri* thus: "Shell small, oval, smooth, with a subglossy surface, the side slopes almost straight. Anterior valve smooth except for six tiny nodules close to the girdle, and slight traces of radial riblets. The animal is dried inside, but the eight slits are easily seen under a pocket lens. Median valves slightly beaked, the jugal and pleural areas smooth, lateral areas raised, well defined, with very faint traces of radial sculpture. Interior one slit, sinus hidden by the animal, colour bluish, insertion-plates probably white. Posterior valve, mucro central, moderately prominent, posterior slope rather steeply concave, bounded by a nearly smooth rib. Interior eight slits. Colour: Ground-colour cream, mottled with dull green and small longitudinal flecks of light brown; the whole surface densely covered with microscopic white speckles. Girdle scales very finely closely striate, rounded, the largest along the centre, the outer edge with three or four rows of very fine outstanding spicules, which are easily rubbed off. Colour creamy transversely banded with green and tinged with brown. Measurements: Length, 10.5 mm.; breadth, 7 mm. Lyall Bay, Cook Strait, N.Z. Remarks: This species appears to be more closely related to *Rhyssoplax translucens* (H. & H.) of Australia, than any other New Zealand member of this genus. It differs from *R. translucens* in being smoother and much smaller, while the girdle scales are proportionately larger and rounder."

This was obviously the young stage of *R. aerea*, and Finlay very soon after recorded this fact. A figure of the type of *oliveri* is here given as an example of the growth stage.

This species appears to range throughout New Zealand from Auckland to Auckland Islands. There seems to be geographical variation, but not enough to separate the forms into species.

Dimensions: Up to 50 x 30 mm.

Station: Under stones below half tide, as in most other species of *Rhyssoplax*.

54. RHYSSOPLAX EXASPERATA.

(Plate ix., fig. 14.)

1914. *Rhyssoplax exasperata* Iredale, Proc. Mal. Soc., xi., 41, pl. ii., fig. 13. March. Sunday Island, Kermadec Group. Type in Canterbury Museum, Christchurch, New Zealand.
1915. *Rhyssoplax corypheus* subsp. *exasperata* Oliver, Trans. N.Z. Inst., xlvii., 1914, 558.

A long and complete account was furnished at the description of this species, as here transcribed: "Shell of medium size, broadly elongate oval, elevated, not definitely keeled, side slopes nearly straight, girdle scaly. Colour variable, green, splashed with lighter or darker, being the predominant tints; the green may be very pale or dark; white prevails in a few specimens, but no absolutely uniformly coloured shell was obtained, though practically a white one and a black-brown one were noted. Anterior valve rayed with twenty raised ribs, slightly nodulous; at the outer edge intercalating riblets occur in adult specimens. Median valves have their lateral areas similarly four or five ribbed; the pleural areas are sculptured with slanting very closely packed sulci, twelve or more in number, none of which reach the anterior edge of the valve, and vanish before the dorsal area is reached, thus leaving the jugal tract smooth and polished. Posterior valve has the mucro elevated, before the centre, the anterior portion sculptured as the pleural areas of the median valves, the posterior plate less projecting than anterior, the ribs being fifteen or sixteen and more nodulous in character. Inside coloration greenish, but varying a little, according to the external coloration. Anterior valve has a slightly projecting insertion-plate regularly cut by eight slits, the teeth beautifully pectinated. Median valves with the insertion-plate one-slit, the sutural laminae low and broad, the sinus narrow and finely denticulate. Posterior plate less projecting than anterior, but more developed at side than centre; the slits number eleven, but one is disproportionate, whilst the others are fairly equal, thereby suggesting twelve to be the normal number. Girdle covered with small oval scales, very closely imbricating, and regularly finely grooved (the apices smooth).

"The above description is drawn up from a normal specimen selected as type. Some specimens are almost keeled, with fewer sulci, less slanting, on the pleural areas, whilst sometimes the anterior valve-ripping lacks nodulosity altogether, and in other cases it is well pronounced. A very juvenile specimen, 5 mm. long, is smooth throughout, the surface minutely quincuncially granulose. It recalls *Chiton translucens*, Hedley and Hull. Specimens, 6.5 to 7 mm. long, are still smooth, but there now appear five or six sulci on the pleural areas. In some concentric growth lines can be observed. These suggest the *Ch. jugosus* Gould, group, especially *Ch. torrianus* Hedley and Hull. An older shell, though only 6 mm. long, shows the ribbing on the anterior valve to commence on the outside, fourteen being counted, which extend less than one-third the distance to the apex; the lateral areas are more strongly marked than in the preceding stage, a slight depression indicating the differentiation into ribbing; at the edge of the posterior valve nine nodules mark the beginning of the radial ribs; the pleural areas are sculptured, with six clean-cut sulci, which extend across the valve. Specimens, 10 mm. long, in some cases show little advancement on the previous stage, whilst in others they show almost perfectly developed adult sculpture. Length of type, 18; breadth, 10.5 mm. Habitat:

Sunday Island, Kermadec Group. Station: On the underside of clean, smooth stones below low tides. It is very close indeed to *Ch. corypheus* Hedley and Hull, but superficially the Kermadec shell has the ribbing on the anterior and posterior valves less nodulous, which is also the case with the lateral area sculpture of the median valves. Closer examination shows the scales on the girdle to be smaller in the Kermadec species, whilst the sulci on the pleural areas of the median valves are weaker. Internally, as was anticipated, little distinction can be seen, but the sinus in the Kermadec shells is noticeably narrower."

55. *RHYSSOPLAX CORYPHEA*.

(Plate ix., figs. 17-20.)

1912. *Chiton corypheus* Hedley and Hull, Proc. Linn. Soc. N.S.W., xxxvii., 277, pl. xii., figs. 6, 6a-c. Norfolk Island. Type in Australian Museum, Sydney.

The original description offered reads: "Shell elevated, carinated, side slopes convex, of medium size. Colour extremely variable, both in shade and pattern, yet two groups appear, one lighter and the other darker. The girdle is usually tessellated with light and dark. A line along the dorsal area is apt to be differentiated by being lighter or darker than the rest. Frequently the umbones are tipped with pink. Sometimes one or two valves oppose a sharp contrast to the rest. No monochromes appear; buff, olive-green, pink, and rarely white display an infinite variety of splashes or marbling. Anterior valve with 14-18 strongly raised granular riblets, increasing in size towards the margin; in mature examples the riblets are multiplied by splitting of the fewer radii of the younger shell. Posterior valve; mucro prominent, in front of the centre, with 14-16 radial riblets similar to anterior valve; central area similar to median valves. Median valves; lateral areas raised, with 2-4 prominent granular riblets, with shorter ones intercalating with age; central areas furrowed by 8-10 longitudinal sulci becoming obsolete anteriorly; jugal tract smooth and polished. Girdle unusually broad, scales finely transversely striate, polished at the margin. Interior green, becoming paler at the margin. Sinus narrow and deep. Anterior valve having 8, median 1-1, and posterior valve 10 slits. Length, 18 mm.; breadth, 10 mm. Station: On the under surface of loose stones in pools on the coral reef; on the under side of or in the interstices between large basalt boulders, or on the surface of the rock in 'potholes.' Habitat: Norfolk Island. Remarks: This shell appears to approach *C. discolor* Souverbie, of New Caledonia, but differs from that species in the fewer radial ribs on the end valves, and the fewer and less anteriorly prolonged sulci in the central areas. *Chiton canaliculatus* Quoy and Gaimard, from New Zealand, is also related, but is more elevated and sharper keeled and has a harsher sculpture."

[56. *RHYSSOPLAX WHITLEYI*, *sp. nov.*

(Plate ix., figs. 15, 16.)

Shell rather small, of medium elevation, side slopes a little curved, sculpture of nodulous radials on anterior valve, lateral areas of median valves and post-mucronal area, the pleural areas lightly sulcate, girdle scales striate. Coloration somewhat varied. The type and largest specimen has the anterior valve pale green, the posterior edges darker, as is the umbonal area; the second valve is creamy white; the third, fourth and fifth grading from pale green to blackish green; the sixth and seventh

creamy again, and the eighth pale green; the girdle is pale green, banded with whitish. The others of the series vary from green to blackish green to creamy and pinkish white, more or less mottled or spotted with green, the girdle generally more or less strongly banded. Anterior valve with about twenty ribs, divaricating at the edges and the apex smooth; the ribs are cut into rather square nodules, or better composed of six or eight squarish nodules.

The lateral areas of the median valves are formed of three or four similar ribs, and the post-mucronal area shows fourteen, the nodules more distinct, yet the ribs divaricate.

The pleural areas have about ten slanting sulci crossing the valve, the jugal area smooth.

Posterior valve with mucro anti-median, a little elevated, posterior slope straight.

Girdle scales of medium size, beautifully striate.

Internal features normal.

Dimensions: 17 mm. x 10 mm. (type).

Station: Under stones at half tide.

Habitat: Rarotonga, Cook Island. Type in Australian Museum.

This interesting species was collected by Mr. G. P. Whitley, Ichthyologist at the Australian Museum, and is here named to appreciate his great interest, on our behalf, in this group on all his collecting and holiday trips. It is here introduced as Loricates are not common in the Pacific, and Rarotonga is under Neozelanic control. This was the only species found and appears to be related to the Norfolk Island *R. coryphea*, and the Kermadec Island *R. exasperata*, while the Huahine and Anaa *Chiton pacificus* Thiele (Rev. Chitonon (Chun Zool., heft 56), 93, pl. x., figs. 1-4, 1910) seems more distant.]

57. RHYSSOPLAX HUTTONI.

(Plate ix., figs. 8, 9.)

1906. *Chiton huttoni* Suter, Trans. New Zeal. Inst., 38, 1905, 320, pl. xviii., figs. 1-6. Near Dunedin, N.Z. Type in Coll. Suter, now in Wanganui Museum, N.Z.
1905. *Chiton huttoni* Suter, Journ. Malac., xii., 70. December 30. *nomen nudum*.
1913. *Chiton huttoni* Suter, Man. N.Z. Moll., 38. Atlas, pl. 2, fig. 17; pl. 4, fig. 12.
1915. *Rhyssoplax huttoni* Iredale, Trans. N.Z. Inst., 47, 1914, 426.
- [1924. *Rhyssoplax huttoni* Odhner, Vidensk. Medd. Dansk. Nat. Foren. Bd., 77 (N.Z. Moll.), 9. North I., South I., Stewart I., is *S. sinclairi*, *fide* Finlay, Trans. N.Z. Inst., 57, 1926, 334, from specimens ex Odhner.]

Suter gave an excellent description, as follows: "Shell oblong-ovate, angularly raised, valves striated throughout, jugum smooth, girdle with rounded scales; colour yellowish-olive, dull to dark green or brick-red; interior whitish. The flatly convex anterior valve has seventeen to twenty-four subequal riblets reaching to the apex, and broken up by concentric rugae of growth; sometimes a few riblets are interspersed, which do not extend to the apex; the latter is smooth, and mostly a little excavated posteriorly. The intermediate valves have the jugum smooth, projecting a little behind; the pleural tracts have about twenty to twenty-five furrows on each side, which near the central area are narrow and not deep, but

usually widening and deepening on approaching the margin. Sometimes they are in breadth equal to the riblets, but in some specimens they are narrower. They extend the whole length of the pleural areas. The lateral areas are strongly ribbed, the ribs broken up by the continuance of the grooves on the pleural tracts. Their number is very variable—the usual number is three to four, but sometimes as many as five are found—and some of them may be divaricating, which, however, is not the rule. The posterior valve has the mucro very little behind the middle; the central area is flatly convex, with the same furrows as the pleural tracts of the intermediate valves; the posterior slope is concave, and the posterior area has eighteen to twenty strongly granose riblets reaching up to the apex. The girdle bears roundish medium-sized and compactly imbricating polished scales, which under a powerful lens show faint striation. The colour is very variable; the most common is yellowish-olive, then dull green is met with, and one of these specimens has the end valves blackish-green; one specimen is brownish-black, and one brick-red. The girdle has the same colour as the valves; sometimes dark bands of variable width and irregular in distribution may be seen. The interior is mostly bluish-white, pinkish-white in the red specimen. The sinus is deep and narrow, pectinate. The slits on a specimen I disarticulated are: Head-valve 9, intermediate valves 1-1, posterior valve 15. All teeth are blunt and pectinate; those of the tail valve are very unequal in breadth. The valve callus is rather prominent. Divergence, 115° . Length, 34 mm.; breadth, 20 mm. Habitat: Near Dunedin."

So far this species has only been found near Dunedin, records from Wellington referring to *aerea*, and the northern so-called *huttoni* is here recognised as the misunderstood *stangeri*.

58. RHYSOPLAX CANALICULATA.

(Plate ix., figs. 12, 13.)

1835. *Chiton canaliculatus* Quoy and Gaimard, Voy. de l'Astrol. Zool., iii., 394, pl. 75, figs. 37-42. Tasman Bay, New Zealand. Type in Paris Museum.
1836. *Chiton canaliculatus* Deshayes, Hist. Anim. s. Vert. (Lam.), ed. 2, vii., 502.
1843. *Chiton canaliculatus* Gray, Travels in N.Z. (Dieff.), ii., 246 (coll. by Stanger).
1852. *Chiton insculptus* A. Adams, P.Z.S., 1852, 91, pl. xvi., fig. 4. New Zealand. Type in British Museum.
1872. *Chiton canaliculatus* Hutton, Trans. N.Z. Inst., iv., 1871, 176.
1873. *Chiton canaliculatus* Hutton, Cat. Marine Moll. N.Z., 46.
1873. *Chiton stangeri* Hutton, Cat. Marine Moll. N.Z., 48.
1880. *Chiton stangeri* Hutton, Man. N.Z. Moll., 111.
1880. *Chiton insculptus* Hutton, Man. N.Z. Moll., 112.
1880. *Lepidopleurus canaliculatus* Hutton, Man. N.Z. Moll., 112.
1893. *Chiton canaliculatus* Pilsbry, Man. Conch., xiv., 177, pl. 36, figs. 4, 5-6 (includes *stangeri* and *insculptus* as synonyms).
1897. *Chiton canaliculatus* Suter, Proc. Mal. Soc., ii., 196.
1904. *Chiton canaliculatus* Hutton, Index Faunae N.Z., 86.
1904. *Chiton canaliculatus* (sic) Wissel, Zool. Jahrb. Abt. Syst., 20, 655.
1905. *Chiton canaliculatus* Hamilton, Col. Mus. Bull., No. 1, 36.
1905. *Chiton canaliculatus* Nierstrasz, Notes Leyden Mus., xxv., 150.
1909. *Chiton canaliculatus* Suter, Nachr. Blatt. Deutsch. Mal. Gesell., 75.

1910. *Chiton stangeri* Iredale, Proc. Mal. Soc., ix., 102 (type examined = *canaliculatus*, error)
 1913. *Chiton canaliculatus* Suter, Man. N.Z. Moll., 37. Atlas, pl. 2, fig. 16; pl. 4, fig. 10.
 1915. *Rhyssoplax canaliculata* Iredale, Trans. N.Z. Inst., 47, 1914, 426.
 1924. *Rhyssoplax canaliculata* Odhner, Vidensk. Medd. Dansk. Nat. Foren. Bd., 77 (N.Z. Moll.), 9.
 1924. *Rhyssoplax canaliculata* Finlay, Trans. N.Z. Inst., 55, 518 (littoral near Dunedin).

Quoy and Gaimard described this species as follows: "*Chiton*, elongatus, elevatus, valde carinatus, roseas; valvis triangularibus, longitudinaliter sulcatis, postice crenulatis; pallio tenuissimo squamoso.

"Élégante petite espèce, toujours d'un joli rose, à coquille allongée, rétrécie, élevée, fortement carénée; chaque valve intermédiaire, formant une pointe postérieure. Elles sont fortement striées en long, et ventriculées sur leur bord postérieur. Leur aire laterale est fortifiée d'un triangle bien en relief, qui atteint jusqu'au sommet. Cette espèce de contre-fort a quatre sillons transverses granuleux. Les deux valves terminales ont leurs stries rayonnantes, toutes deux avec dix dents striées, à peine perceptibles dans la postérieure. La coquille recouvrant presque tout le corps, le manteau a peu de développement; il est tapissé de squammes granuleuses extrêmement fines, également rosé, quelquefois taché de brun. Le rouge des aires latérales et du sommet est un peu plus foncé; quelques individus ont des taches triangulaires dans la longueur de ce sommet; d'autres sont verdâtres, maculés de rouge. Le dessous du corps est jaunâtre. On trouve assez souvent cette espèce dans l'anse de l'Astrolabe, à la baie Tasman de la Nouvelle-Zélande. Dimensions: Longueur, 9 lignes. Largeur, 6 lignes. Hauteur, 4 lignes."

A. Adams introduced *Chiton insculptus*: "Shell oblong, much elevated, terminal valves, and the lateral areas of the others radiately ribbed; ribs granular, the granules transverse, rather crowded, obsolete at the margin; umbones keeled; anterior terminal valve umbonated; median area longitudinally strongly lirate; lirae obsoletely rugoso-granulate; median areas red, with two blackish-brown parallel lines down the centre of the valves; mantle with brownish-yellow and brown scales; scales smooth, shining, convex. New Zealand, on dead shells in deep water (Strange)."

Very easily recognisable by its beautiful coloration and striking sculpture, this species is common on the oyster beds of Foveaux Strait, and many specimens have been picked from the dredged oysters. Finlay has, however, recorded specimens from the littoral of Otago.

Twenty years ago Iredale, examining the type of *Chiton stangeri* in the British Museum, in comparison with the shell misidentified at that time, reduced the name to the synonymy of *canaliculatus*, which is incorrect.

Dimensions: 25 x 14 mm.

59. RHYSSOPLAX STANGERI.

(Plate ix., figs. 10, 11.)

1847. *Chiton stangeri* Reeve, Conch. Icon. iv., pl. xxii., sp. and fig. 150. New Zealand (Coll. Stanger). Type in British Museum.

Reeve described this species as follows: "Shell ovate, terminal valves and lateral areas of the rest rayed, with rows of closely packed square appressed granules, central areas smooth in the middle, closely ridged on each

side, interstices rather deep; yellow and green, tessellated with green spots; ligament squamately coriaceous.

Habitat: New Zealand; Dr. Stanger. Dedicated to the honour of another eminent traveller in New Zealand, whose name is worthy of being recorded under the present genus."

Suter recognised a shell collected by Iredale and Oliver as *C. stangeri*, and Iredale, comparing the specimen with the Reevean type, found it to be altogether different and named it *suteri*. The type of *stangeri* was found to be very like *canaliculatus*, and was recorded as a synonym. Many shells have now been collected at Tauranga and regarded as *huttoni*, but Finlay upon comparison with true *huttoni* from Dunedin found them to be separable and pointed them out as a new species. His differential features were easily confirmed, and the species was figured as distinct. Only when writing up the description and comparing critically with *canaliculata* which it mostly resembled was it recognised as the missing *stangeri*.

Reeve's description is exact.

The specimens from Tauranga collected by Dr. Bucknill are here described. Coloration generally yellow-greenish, sometimes with darker spots, the girdle banded. Variation will undoubtedly occur, as some valves may be dark green and the jugal ridge paler, with darker lines adjacent.

The anterior valve is very closely rayed with about twenty-five rays, bifurcating towards the edges and cut into square nodules; the outer edges thickened.

The median valves have the lateral areas similarly ribbed, generally four well defined squarely nodulose rays developed from two; the pleural areas are deeply sulcate like those of *canaliculata*, about fifteen distinct ridges crossing the pleura and suddenly dying away, leaving a narrow distinct smooth jugal area.

The posterior valve is as usual similarly sculptured.

The girdle scales are very small and polished, practically smooth to an ordinary lens.

As above noted, they are very near *canaliculata* in the sculpture of the pleural areas, but are easily separated by the definite squarish noduling of the ribs on the anterior and median valves.

Dimensions: 18 x 11 mm.

Station: Attached to large shells of *Mytilus canaliculatus* on sandbanks submerged at lowest tide.

xxii. Genus AMAUROCHITON.

1893. *Amaurochiton* Thiele, Das Gebiss der Schnecken (Troschel), ii., 362.

Type by monotypy *Chiton olivaceus* Frembly.

1893. *Poeciloplar* Thiele, Das Gebiss der Schnecken (Troschel), ii., 365.

Type by monotypy *Chiton glaucus* Gray.

A very characteristic Neozelanic shell, being the commonest shell after *Sypharochiton*, and even more notable through its striking dark green coloration. It is well defined in its shape, sculpture and girdle scales. The latter differ from those of all the other Neozelanic Loricates in their size and shape, and the South American species, *olivaceus* Frembly, is very closely allied, but much larger. It appears to be indubitably congeneric.

Shell large, rather ovate, sculpture fine, girdle scales peculiar. The insertion-plates are short, finely denticulate, and the slitting is numerous in the end valves, 9-10-14, the median valves having the usual one slit on each side.

60. AMAUROCHITON GLAUCUS.

(Plate ix., figs. 1-7; Plate x., fig. 10.)

1828. *Chiton glaucus* Gray, Spicil. Zool., pt. i., 5. July 1. Hab. ? Type in British Museum.
1835. *Chiton viridis* Quoy and Gaimard, Voy. de l'Astrol. Zool., iii., 383, pl. 74, figs. 23-28. New Zealand. Type in Paris Museum.
1836. *Chiton quoyi* Deshayes, Hist. Anim. s. Vert. (Lam.), 2nd Ed., vii., 509. New name for Quoy and Gaimard's species.
1843. *Chiton viridis* Gray, Travels in New Zeal. (Dieff.), ii., 246.
1847. *Chiton quoyi* Reeve, Conch. Icon., iv., pl. 13, sp. and fig. 68.
1867. *Lophyrus glaucus* Angas, P.Z.S., 222.
1872. *Chiton quoyi* Hutton, Trans. N.Z. Inst., iv., 1871, 177.
1873. *Chiton quoyi* Hutton, Cat. Marine Moll. N.Z., 47.
1880. *Chiton glaucus* Hutton, Man. N.Z. Moll., 112.
1883. *Chiton glaucus* Hutton, Trans. N.Z. Inst., xv., 1882, 129, pl. xvi., fig. f. (dentition).
1893. *Chiton quoyi* Pilsbry, Man. Conch., xiv., 172, pl. xxxvii., figs. 6-8.
1897. *Chiton quoyi* Suter, Proc. Mal. Soc., ii., 194.
1897. *Chiton aereus* Suter, Proc. Mal. Soc., ii., 195. Manukau Harbour. Not *C. aereus* Reeve.
1904. *Chiton quoyi* Hutton, Index Faunae N.Z., 86.
1905. *Chiton quoyi* Hamilton, Col. Mus. Bull., No. 1, 36.
1905. *Chiton quoyi* var. *limosa* Nierstrasz, Notes Leyden Mus., xxv., 151. April 15, ex Suter MS. N.Z.
1905. *Chiton quoyi* subsp. *limosa* Suter, Journ. Malac., xii., 69. December 30. Manukau Harbour, N.Z.
1913. *Chiton quoyi* and subsp. *limosus* Suter, Man. N.Z. Moll., 34. Atlas. pl. 2, fig. 13.
1913. *Chiton quoyi* subsp. *limosus* Suter, Man. N.Z. Moll., 34.
1914. *Amaurochiton glaucus* Iredale, Proc. Mal. Soc., xi., 38.
1915. *Amaurochiton glaucus* Iredale, Trans. New Zeal. Inst., xlvii., 1914, 422, 426.
1923. *Amaurochiton glaucus* May, Illus. Index Tas. Shells, p. xvi., fig. 13.
1924. *Amaurochiton glaucus* Odhner, Vidensk. Medd. Dansk. Nat. Foren. Bd., 77 (N.Z. Moll.), 9.
1926. *Amaurochiton glaucus* Iredale and Hull, Aust. Zool., iv., 256, pl. xxxvii., figs. 1-22.
1927. *Amaurochiton glaucus* Iredale and Hull, Mon. Austr. Loricates, 119, pl. xv., figs. 1-22.

The short description given by Gray reads: "Testa oblonga, convexa, subcarinata, glauca; area centrali regulariter longitudinaliter, laterali valvisque terminalibus radiatim, striatis; margine ——— Inhab. — Mus. Brit. Shell oblong, convex, subcarinate, glaucous green; end valves and lateral area of the middle valves finely and regularly longitudinally grooved; laminae of insertion pectinate. Inside white. Margin destroyed."

A few years later an excellent account was published by Quoy and Gaimard, with beautiful figures, as follows: "Chiton, corpore elongato-ovali, elevato, triangulari, margine squamoso, viridi, albo aut subrubro variegato, subtus lutescenti; valvis tenuissime striatis.

"Petite espèce, ovale, allongée, à dos très-élevé, triangulaire, avec une carène obtuse, d'un beau vert uniforme, un peu foncé dans toutes ses parties, quelquefois tapissé de blanchâtre ou de roux ferrugineux. Le dessous du corps est d'un jaune pâle. Le manteau, fort étroit, est revêtu d'écailles fines, arrondies et serrées, également vertes. Le pied est étroit,

le voile buccal elargi sur les côtes et touchant le cordon branchial. Tous les osselets sont finement striés d'arrière en avant; les dix (sic) inter-médiaires étroits, et de plus un triangle latéral sillonne en long, tandis que les lignes des deux extrêmes vont en rayonnant; le premier a dix dents crénelées, et le dernier quinze. Leur forme est arrondie, tandis que les autres décrivent une voute triangulaire. Les lames d'insertion sont courtes, fortement échancrées, très-finement denticulées sur leurs bords latéraux, et pourvues d'un sillon. Elles sont d'un vert clair, avec une ligne rougeâtre en arrière. Cet Oscabron est assez répandu dans la Nouvelle-Zélande. On le trouve surtout à l'anse de l'Astrolabe. Nous en avons rapporté un grand nombre, tous à peu près de même taille, c'est-à-dire de quatorze lignes de longueur, sur huit de largeur et quatre de hauteur."

Owing to Quoy and Gaimard selecting a preoccupied name this fine species was renamed by Deshayes, *Chiton quoyi*, and for eighty years it was thus known, though the identity with Gray's species had been recorded. Such an unmistakable form was easily recognised, and consequently there is practically no complication, a narrow small form being mistaken for the missing *aereus* by Suter, and then distinguished as a subspecies. Curiously enough, specimens labelled by Suter having been sent abroad, the first publication was made by Nierstrasz, who wrote: "*Chiton quoyi* var. *limosa*. 1 Exemplar von Neu-Seeland mit der Etiketle; var. *limosa* Suter. Diese Varietat ist mir unbekannt. Die Lange beträgt 19 mm., die Breite 13 mm. Die Schalen sind gelbweiss und unregelmässig grün gestreift und gefleckt. Die Schuppen sind weiss, grün oder gelbbraun gefarbt."

Suter's publication took place nearly nine months later, when he recorded: "It differs from the species (*C. quoyi*) in being smaller and narrower, the jugum angled, not carinated, not always smooth, colour yellowish to green, mostly coated with blackish green. Anterior valve with 8, posterior valve with 15 slits, divergence about 100°, against 120° in the species."

Dimensions: Up to 40 x 25 mm.

Living between tide marks in considerable numbers many colour varieties have been met with, but it may be noted that probably these are much more common in the North Island than in the South Island, as some years collecting in the South Island by Iredale and Oliver provided very few colour aberrations, though many thousands of shells were seen.

xxiii. GENUS SYPHAROCHITON.

1896. *Sypharochiton* Thiele, Das Gebiss der Schnecken (Troschel), ii., 365.

Type by monotypy *Chiton pelliserpentis* Quoy and Gaimard.

1893. *Triboplax* Thiele, Das Gebiss der Schnecken (Troschel), ii., 365.

Type by monotypy *T. scabricula* = *C. pelliserpentis* Quoy and Gaimard.

The typical *Sypharochiton* is not confined to New Zealand, but also occurs on the east coast of Australia, from Sydney to the south and west of Tasmania. There is a hiatus in southern New South Wales.

The species are large, round-backed shells with rather crude sculpture (when contrasted with *Rhyssoplax*), and large oval striate girdle scales. The internal features are very characteristic, the short thick teeth of the insertion-plates, very coarsely denticulate, being quite unlike those of any other Neozelanic group, while the large separated scales are also diagnostic. The slitting in the anterior valve is always more than eight, and in the posterior twelve, the median with the usual one on each side. Some small shells are here associated, but more research is necessary to determine their exact relationship.

61. SYPHAROCHITON PELLISERPENTIS.

(Plate ix., fig. 21.)

1835. *Chiton pelliserpentis* Quoy and Gaimard, Voy. de l'Astrol. Zool., iii., 381, pl. 74, figs. 17-22. Astrolabe Bay, New Zealand. Type in Paris Museum.
1836. *Chiton pelliserpentis* Deshayes, Hist. Anim. s. Vert. (Lam.), ed. 2, vii., 508.
1843. *Chiton pelliserpentis* Gray, Travels in N.Z. (Dieff.), ii., 246.
1847. *Chiton pelliserpentis* Reeve, Conch. Icon., iv., pl. xv., sp. and fig. 64.
1872. *Chiton pelliserpentis* Hutton, Trans. N.Z. Inst., iv., 1871, 176.
1873. *Chiton pelliserpentis* Hutton, Cat. Marine Moll. N.Z., 46.
1880. *Chiton pelliserpentis* Hutton, Man. N.Z. Moll., 111.
1883. *Chiton pelliserpentis* Hutton, Proc. Linn. Soc. N.S.W., xv., 1882, 129, pl. xvi., fig. 1 (dentition).
1886. *Chiton pelliserpentis* Haddon, Rep. Zool. Challenger, xv., Polypl., 22.
1893. *Chiton pelliserpentis* Pilsbry, Man. Conch., xiv., 173, pl. 37, figs. 14-18.
1897. *Chiton pelliserpentis* Suter, Proc. Mal. Soc., ii., 195.
1904. *Chiton squamosus* Wissel, Zool. Jahrb. Abt. Syst., 20, 619. Error only.
1904. *Chiton pelliserpentis* Hutton, Index Faunae N.Z., 86.
1905. *Chiton pelliserpentis* Hamilton, Col. Mus. Bull., No. 1, 36.
1908. *Chiton pelliserpentis* Iredale, Trans. N.Z. Inst., xl., 1907, 375, pl. xxxi. (five-valved aberration).
1909. *Chiton squamosus* Suter, Nachr. Blatt. Deutsch. Malak. Gesell., 74. Correction of Wissel's error.
1913. *Chiton pelliserpentis* Suter, Man. N.Z. Moll., 33. Atlas, pl. 2, fig. 12; pl. 4, fig. 6.
1915. *Sypharochiton pelliserpentis* Iredale, Trans. N.Z. Inst., 47, 1914, 426.
1922. *Sypharochiton pelliserpentis* Ashby, Trans. Roy. Soc. South Austr., xlv., 579 (type examined?).
1924. *Sypharochiton pelliserpentis* Odhner, Vidensk. Medd. Dansk. Nat. Foren. Bd., 77 (N.Z. Moll.), 8.

This, the most common Loricata in New Zealand, was well described by Quoy and Gaimard, as: "Chiton, corpore ovato-rotundo, squamoso, virescenti, lineis nigris notato, subtus luteo; valvis fusco-virescentibus, in medio macula nigra signatis.

"Assez petite espèce, presque orbiculaire, à dos élevé, à manteau peu large sur les côtes, recouvert de fines écailles arrondies, bien imbriquées, verdâtres, marqué de sept à huit lignes brunes transversales, ce qui fait ressembler cette partie à la peau de notre couleuvre ordinaire. Le dessous du corps est d'un jaune clair, et le chaperon céphalique légèrement denticulé; on compte environ trente-quatre folioles à chaque branchie, qui le touche presque. Les valves sont finement écailleuses, verdâtres, quelquefois légèrement jaunâtres, avec des taches brunes irrégulières sur les côtes, mais toujours marquées, moins les extrêmes, d'un triangle noir au milieu. Elles sont larges, étroites, très-surbaissées, la seconde la plus large de toutes, finement striées, avec un triangle granuleux aux aires latérales. En dessous elles ont une arête arquée verte, et leurs côtés fortement denticulés; les apophyses, étroites, larges, échancrées, sont d'un assez joli vert clair. La première valve a onze dents courtes, striées, la dernière treize; toutes deux ont des granulations qui forment des lignes rayonnantes. Les quatre osselets intermédiaires sont presque de même grandeur; le quatrième a onze lignes d'étendue. Cette espèce, que les lignes transverses de son manteau font un peu ressembler à la précédente, est extrêmement com-

mune dans l'anse de l'Astrolabe, a la Nouvelle-Zélande. Nous croyons en avoir recueilli deux ou trois cents dans un instant. Dimensions: Longueur des plus grands individus, 14 lignes. Largeur, 13 lignes."

Shell of medium size, depressed, round-backed, elongately ovate, girdle scales large ovals, sculpture crude. Coloration somewhat varied, mostly green, brown and black, variously striped, perfect unicolours rare, girdle generally banded, recalling snakeskin, hence the specific name. Anterior valve ribbed, ribs distant, cut into coarse squarish nodules; ribs fifteen to twenty, divaricating at the edges. Lateral areas of the median valves, as also the post-mucronal area similarly sculptured, three or four ribs on the former and twelve to fifteen on the latter. The pleural areas closely longitudinally ridged and crossed with rather deep concentric growth lines. Mucro of the posterior valve elevated, submedian, posterior slope straight. The sculpture may be a little modified, but never reaches the stage of *sinclairi*, and even, if worn, can be separated from that species by means of the striae, not glossy, girdle scales.

Dimensions: 35 x 25 mm.

Station: On or under stones above median tide mark.

62. SYPHAROCHITON SINCLAIRI.

(Plate x., figs. 1, 2.)

1843. *Chiton sinclairi* Gray, Travels in New Zeal. (Dieff.), ii., 263 (mid January). Great Barrier Island, North Island. Type in British Museum.
1847. *Chiton sinclairi* Reeve, Conch. Icon., iv., pl. 22, fig. 143.
1872. *Chiton sinclairi* Hutton, Trans. N.Z. Inst., iv., 1871, 177.
1873. *Chiton sinclairi* Hutton, Cat. Marine Moll. N.Z., 46.
1874. *Chiton (Leptochiton) sinclairi* Smith, Voy. Erebus and Terror, Zool. Moll., 4, pl. i., fig. 17 (type figured).
1880. *Chiton (Leptochiton) sinclairi* Hutton, Man. N.Z. Moll., 111.
1893. *Chiton sinclairi* Pilsbry, Man. Conch., xiv., 174, pl. 36, figs. 1-3.
1897. *Chiton sinclairi* Suter, Proc. Mal. Soc., ii., 196.
1904. *Chiton sinclairi* Hutton, Index Faunae N.Z., 86.
1905. *Chiton sinclairi* Hamilton, Col. Mus. Bull., No. 1, 36.
1913. *Chiton sinclairi* Suter, Man. N.Z. Moll., 35. Atlas, pl. 2, fig. 14; pl. 4, fig. 7.
1915. *Sypharochiton sinclairi* Iredale, Trans. N.Z. Inst., 47, 1914, 426.
1922. *Sypharochiton pellisserpentis* var. *sinclairi* Ashby, Trans. Roy. Soc. South. Austr., xlv., 579.
1924. *Chiton huttoni* Odhner, Vidensk. Medd. Dansk. Nat. Foren. Bd., 77 (N.Z. Moll.), 8, *vide* Finlay.

Gray shortly described this beautiful species as follows: "Pale brown, polished, the terminal valves with many, and the lateral area with few indistinct broad nodulose ridges, the central area polished, with pale longitudinal streaks, and with a few short, deep, irregular longitudinal grooves on the hinder edge of the sides. This species is very like *C. pellisserpentis*, but is polished, and the central plates are smooth, except at the outer angles."

This description is quite good when the correct shell is compared, and most local collectors have been able to discriminate it without difficulty, but Ashby confused it, writing: "One of the three (*pellisserpentis*) is quite as carinated as *S. sinclairi* Gray." We have never seen nor heard of a carinated *sinclairi*, whose chief feature is its low round back.

Compared with the preceding species, the ribbing on the anterior valve

and lateral areas is much weaker, and the noduling is more or less obsolete, though the growth lines are generally much more pronounced.

The ribbing on the pleural areas is generally obsolescent; when present only a few slight ridges appearing near the lateral edges. The coloration is generally diagnostic, being blackish longitudinally boldly splashed with white. Unicolour varieties are seldom met with. The whole shell is glossy, and this applies to the girdle scales, so that whatever state the shell may be in, the girdle scales will determine it. Sometimes a specimen of the preceding species may be met with in which the sculpture is modified, and it may even show a rather shining surface, but upon actual comparison the differences become striking.

Dimensions: Up to 30 x 18 mm.

Station: Between tide marks mainly under stones in rock pools.

63. *SYPHAROCHITON TORRI*.

(Plate x., fig. 12.)

1907. *Chiton torri* Suter, Proc. Mal. Soc., vii., 295, fig. 2, in text. Bluff Harbour, New Zealand. Type in Torr Collection, South Australia.

1913. *Chiton torri* Suter, Man. N.Z. Moll., 35. Atlas, pl. 4, fig. 8.

1915. *Sypharochiton torri* Iredale, Trans. N.Z. Inst., 47, 1914, 426.

Suter's description reads: "Shell small, elongate, smooth, dark brown. Anterior valve with eleven indistinct riblets, obsolete in one specimen, crossed by fine growth lines, the whole surface minutely wrinkled. Of the intermediate valves, the first is twice as long as the others; all of them are broadly rounded, smooth, and beaked, the central areas with minute transverse zigzag wrinkles; jugum smooth; lateral areas slightly raised, with concentric ridges, very distinct near the margins, but gradually disappearing towards the centre, the whole minutely wrinkled. Posterior valve with the mucro central, low, posterior slope strongly convex, a few concentric ridges near the margin, surface wrinkled like the other valves. Girdle with small, rounded, smooth, imbricating scales. Colour dark brown, somewhat lighter on the central and lateral areas; girdle darker brown, nearly black. Interior light brown, sinus microscopically denticulate, sutural laminae moderately high, and broadly rounded. Anterior valve with 11 slits, teeth sharp and pectinate, irregular in size. Intermediate valves with one slit on each side. Posterior valve with a low insertion-plate, having 12 slits, the teeth thick and blunt, with one or two grooves on the outside. Length, 9; breadth, 4.5 mm.; divergence, 100°. Habitat: Bluff, South Island (Dr. Torr). It is easily distinguished from all the other New Zealand species of the genus by the almost total smoothness, the small size, and the microscopic wrinkles. It is nearest allied to *C. sinclairi*."

Since collected by Mr. W. R. Oliver, Director of the Dominion Museum, also at the Bluff.

64. *SYPHAROCHITON THEMEROPIIS*.

(Plate x., fig. 16.)

1914. *Sypharochiton themeropsis* Iredale, Proc. Mal. Soc., xi., 43, pl. ii., fig. 14. March. Sunday Island, Kermadec Group. Type in Canterbury Museum, Christchurch, New Zealand.

1915. *Sypharochiton themeropsis* Oliver, Trans. New Zeal. Inst., 47, 1914, 553.

The original description is here reproduced: "Shell small, oval, elevated, keeled, side slopes almost straight, valves beaked, girdle scaly. Colour black; majority of specimens considerably eroded. Anterior valve with sixteen to twenty strictly radial rows of separated tubercles, the

intervals minutely pustulose, the pustules being flat-topped and circular. Median valves with their lateral areas showing three or four separated tuberculose radial rows, the intervals pustulose; the pleural areas regularly pustulose, with no arrangement whatever into longitudinal rows. Posterior valve with the mucro elevate, sub-central, slightly anterior, the posterior slope faintly convex. The anterior portion is sculptured as the pleural areas of the median valves, the posterior as the anterior valve, with few strictly radial rows of separated tubercles. Inside coloration dark blue-green. Insertion-plate of anterior valve with ten to twelve slits, the teeth coarsely pectinated and thick; the plate short, but somewhat projecting, and the slits irregular. Teeth pale green. Median valves have the insertion-plate one-slit, the posterior tooth short and stopping very abruptly before reaching the lateral edge of the valve. The sutural laminae are pale green, rounded, low, and widely separated; the tegmentum generally approaches between, but, when the plate is recognisable, it is seen to be strongly denticulate. Posterior valve with the plate very short and somewhat thrown backward; the slits, ten to twelve in number, are very irregular, while the teeth are thick and coarsely pectinate. The girdle is covered with medium size, rounded, a little separated, deeply grooved scales. The grooves number five to seven on a scale. This description is drawn up from a young shell, as old shells are too much eroded for any sculpture to be determined, save the ends of the radial rows of tubercles; such are more elevated than younger shells. Length of type, 9; breadth, 5 mm. Length of largest specimen, 17.5; breadth, 10.5 mm. Habitat: Sunday Island, Kermadec Group. Station: In crevices of rocks between tides. 'A Chiton was procured which had developed most peculiar habits; it lived in crevices of rocks between tide marks, huddling together, half a dozen being found one upon another, so that some did not touch the rock at all. This species was entirely black, and allied to *pellisserpentis* Quoy and Gaimard. . . . ' *Sypharochiton themeropsis* differs from *Ch. funereus* in colour, shape, sculpture, girdle scales, and internal structure. *S. themeropsis* is a heavy crass shell, whilst *Ch. funereus* is a delicately formed species; the former is always dead black, the latter varies from black to light brown, green, striped forms, etc.; the former is a somewhat elongate oval, the latter is a very broad oval; in the former the anterior valve is radially rowed with tubercles, the rows very distinct and widely separated; in the latter the tubercles are smaller, much more closely packed, and no distinct rows appear; in the former the pustules on the pleural areas of the median valves never show lineal arrangement; in the latter this is generally the case. The girdle scales in *S. themeropsis* are deeply grooved with a few grooves; in *Ch. funereus* the girdle scales are finely striate. The dissected specimens compared show that in this state no confusion is possible; in the Kermadec shell the insertion-plates are comparatively long, with thick coarsely pectinated teeth, whilst in *Ch. funereus* the insertion-plates are very degraded, with the teeth very minute, and bearing very fine striae. The differences are so pronounced as to suggest that *Ch. funereus* can scarcely rank in typical *Sypharochiton*, whilst *S. themeropsis* needs comparison with the type of that genus. *S. themeropsis* can be readily distinguished from *S. pellisserpentis* (Quoy and Gaimard) by its smaller size, grooved girdle scales, and lack of longitudinal sculpture on the pleural areas of the median valves."

65. *SYPHAROCHITON FUNEREUS*.

(Plate x., figs. 14, 15.)

1912. *Chiton funereus* Hedley and Hull, Proc. Linn. Soc. N.S.W., xxxvii., 279,

pl. xiii., figs. 8, 8a. Lord Howe Island. Type in Australian Museum, Sydney.

The original description is here given: "Shell broad, elevated, carinated, side slopes almost straight. Colour dark green or black, rarely red-brown, occasionally flared with lighter. Anterior valve densely covered with small rounded pustules, which tend to radial and concentric arrangement. Posterior valve irregularly pustulose, mucro prominent, in front of the middle. Median valves; lateral areas raised, strongly ribbed with 3-4 pustulose riblets, bifurcating towards the margin; the pustules of the lateral areas extending into the outer angles; central areas finely sculptured with irregular wavy lines. Girdle alternately banded with light and dark; densely clothed with large scales, not polished, striate. Interior deeply bluish-green, sinus broad, shallow; anterior valve having 10-12, median 1-1, and posterior valve 12 slits. Length, 13 mm.; breadth, 9 mm. Station: Under stones on the coral reef and elsewhere at low tide. Habitat: Lord Howe Island (type locality) and Norfolk Island."

xxiv. Genus ONITHOCHITON.

1847. *Onithochiton* Gray, P.Z.S., 65. Type by subsequent designation Gray, P.Z.S., 1847, 168, *Chiton undulatus*.

This is a characteristic genus of the Neozelanic littoral, the brightly coloured clean shell with the broad fleshy non-scaly girdle attracting attention. Shell oval, elevated, smooth and shining, girdle broad and fleshy; eyes present.

The only sculpture is seen in imperfect rays of small nodules on the anterior valve and lateral areas.

Internally the features are well marked; the insertion-plates of the anterior and median valves are short, finely denticulate and regularly slit. eight in anterior valve, one on each side of the median valve, while there is only a callus present in the posterior valve, the mucro being terminal; that this is due to degeneracy is clearly seen by study of juveniles which show a median mucro and a regular but slight insertion-plate.

The well developed "eyes" are a notable feature of this group.

66. ONITHOCHITON NEGLECTUS.

(Plate x., figs. 18, 19.)

1881. *Onithochiton neglectus* Rochebrune, Bull. Soc. Philom. Paris, 7, Ser. v., 120. Wellington, New Zealand. Type in Paris Museum.

1835. *Chiton undulatus* Quoy and Gaimard, Voy. de l'Astrol. Zool., iii., 393, pl. 75, figs. 19-24. Bay of Islands, New Zealand. Type in Paris Museum. Not *Chiton undulatus* Wood.

1836. *Chiton undulatus* Deshayes, Hist. Anim. s. Vert. (Lam.), Ed. 2, vii., 537.

1843. *Acanthopleura undulatus* Gray, Travels in N.Z. (Dieff.), ii., 245.

1847. *Chiton undulatus* Reeve, Conch. Icon., iv., pl. xvi., figs. 87, 90.

1857. *Onithochiton undulatus* H. and A. Adams, Gen. Rec. Moll., 476, pl. 54, fig. 3.

1872. *Tonicia undulata* Hutton, Trans. New Zeal. Inst., iv., 1871, 179.

1873. *Tonicia undulata* Hutton, Cat. Marine Moll. N.Z., 48.

1880. *Tonicia undulata* Hutton, Man. N.Z. Moll., 114.

1881. *Onithochiton astrolabei* Rochebrune, Bull. Soc. Philom. Paris, 7th Ser., v., 120. New Zealand (Quoy and Gaimard). Type in Paris Museum.

1881. *Onithochiton filholi* Rochebrune, Bull. Soc. Philom. Paris, 7th Ser., v., 120. Cook Straits, N.Z. Type in Paris Museum.

1882. *Onithochiton decipiens* Rochebrune, Bull. Soc. Philom. Paris, 7th Ser., vi., 196. Cook Straits, N.Z. Type in Paris Museum.
1893. *Onithochiton undulatus* Pilsbry, Man. Conch., xiv., 245, pl. lv., figs. 14-16.
1893. *Onithochiton semisculptus* Pilsbry, Man. Conch., xiv., 247, pl. 55, figs. 10-11. Habitat unknown. Type in Acad. Nat. Sci., Philadelphia.
1893. *Onithochiton filholi* Pilsbry, Man. Conch., xv., 106 (translation).
1893. *Onithochiton decipiens* Pilsbry, Man. Conch., xv., 106.
1893. *Onithochiton neglectus* Pilsbry, Man. Conch., xv., 106.
1893. *Onithochiton astrolabei* Pilsbry, Man. Conch., xv., 107.
1897. *Onithochiton undulatus* Suter, Proc. Mal. Soc., ii., 199.
1904. *Onithochiton undulatus* Hutton, Index Faunae N.Z., 86.
1904. *Onithochiton semisculptus* Hutton, Index Faunae N.Z., 86.
1905. *Onithochiton undulatus* Hamilton, Col. Mus. Bull., No. 1, 36.
1905. *Onithochiton undulatus* Nierstrasz, Notes Leyden Mus., xxv., 157.
1905. *Onithochiton semisculptus* Suter, Journ. Malac., xii., 71 (recognised from Chatham I.).
1910. *Onithochiton filholi* Iredale, Proc. Mal. Soc., ix., 154.
1913. *Onithochiton semisculptus* Suter, Man. N.Z. Moll., 48. Atlas, pl. 2, fig. 23.
1913. *Onithochiton undulatus* Suter, Man. N.Z. Moll., 49. Atlas, pl. 2, fig. 24; pl. 5, fig. 5.
1915. *Onithochiton neglectus* Iredale, Trans. New Zeal. Inst., 47, 1914, 423, 426.
1922. *Onithochiton neglectus, undulatus, astrolabei* Ashby, Trans. Roy. Soc. South Austr., xlv., 582 (types examined?).
1924. *Onithochiton neglectus* Odhner, Vidensk. Medd. Dansk. Nat. Foren. Bd., 77 (N.Z. Moll.), 9.

The excellent description and figures given by Quoy and Gaimard allowed easy recognition of this striking Loricata, and the invalidity of their chosen name was temporarily ignored. Their account reads:—

"Chiton, corpore parvo, subcarinato, margine griseo vel rubente, tomentoso; valvis cordiformibus, postice acutis, levibus, roseis vel rubescentibus, undulatis transversimque lineolatis.

"Cette petite espèce tient, au premier aspect, de l'Oscabrion lamelleux, dans sa variété verdâtre, dont les linéoles simulent des stries. Elle est courte, ovale, à dos élevé, caréné. Les valves intermédiaires sont uniformes, un peu en cœur, pointues en arrière, la seconde la plus ample de toutes. Elles sont complètement lisses, polies, rosées, ou légèrement verdâtres et marquées de linéoles transverses, ondulées, de l'une ou l'autre couleur, selon celle du fond. On remarque à la loupe, sur les aires latérales, des rangées longitudinales de points noirs; ils recouvrent la première valve. Quelques individus ont une teinte rosée au milieu, et des taches vertes sur les côtes. Le manteau, assez large, est rougeâtre et rendu tomenteux par une foule de petits poils courts. La première valve a neuf dents ciliées; la dernière en manque à sa lame d'insertion. Les autres apophyses ont une échancrure arrondie, et toutes les valves sont marquées, à l'intérieur, d'un triangle couleur de rose, caractère qui suffirait pour faire distinguer cette espèce remarquable par l'élégance et la disposition de ses couleurs. Le pied est rose pâle ou jaunâtre; on compte vingt-neuf lamelles branchiales de chaque côte, assez distants du chaperon céphalique. Ils perdent dans la liqueur leur couleur rosée, mais conservent fort bien la verte. Ils sont

assez communs à la baie des Iles de la Nouvelle-Zélande. Dimensions: Longueur, 11 lignes. Largueur, 7 lignes. Hauteur, 3 lignes."

No complications whatever ensued until the erratic and irresponsible Rochebrune ran riot among these shells in the Paris Museum. Using a classification of his own which has defied interpretation, he lost, mislaid and transferred labels and specimens, describing the types of former workers under different genera and then renaming his own new species until there is no confidence in any specimens of this class in that Museum. Thiele examined the material and made possible some determinations, and later Iredale critically studied the series, with the result that, while some forms were fairly recognisable, others were seen to be absolutely indeterminate. Then Dupuis came along and completed Rochebrune's work, labelling and disarranging and distributing the original material so that the data allotted is now worse than valueless. Ashby then glanced at the collection and gave some notes on the supposed types, but it is obvious that he was simply following Dupuis' valueless arrangement, and it would be wise to ignore all these reports at the present time. The fact that Dupuis selected unique types (probably unwittingly) for his own collection indicates his ignorance of their value.

Rochebrune's attack on the present species reads (using Pilsbry's translations for convenience of comparison):—

"*Onithochiton neglectus*. Shell ovate-elliptical, subcarinated; brown with scattered buff or buffish maculae. Anterior valve and posterior part of the posterior valve most minutely granulose. Intermediate valves having the central areas smooth, lateral areas radially granose. Marginal ligament very wide, brown, satiny. Length, 26 mm.; breadth, 17 mm. Wellington, New Zealand (Quoy and Gaimard). Rare. Paris Museum."

"*Onithochiton astrolabei*. Shell ovate; rubescent or green, conspicuously ornamented with concentric brown lines. Valves transversely rather narrowed, smooth. Lateral areas obscurely lirate, longitudinally and laterally lineated, the lines granulose. Marginal ligament wide, brownish, silky. Length, 16 mm.; width, 10 mm. New Zealand (Quoy and Gaimard). Rare. Paris Museum."

"*Onithochiton filholi*. Shell ovate, wide, subcarinated; intense olivaceous concentrically ornamented with alternating buff and green lines. Anterior valve radially striated; posterior part of posterior valve lightly sulcate. Intermediate valves smooth on the central areas; the lateral areas most minutely radially striated, at the posterior part, strongly and concentrically bi-lirate. Marginal ligament wide, rubescent, silky. Length, 29 mm.; width, 18 mm. Cook Straits (Filhol). Common. Paris Museum."

"*Onithochiton decipiens*. Shell ovate, wide, subcarinate; olivaceous ornamented with concentric buff lines. Anterior valve radially striated; intermediate valves having the central areas smooth; lateral areas radially most minutely striated, laterally concentrically bi-lirate. Ligament wide, rubescent, silky. Length, 29 mm.; width, 18 mm. Cook Straits (Filhol). Rare. Paris Museum."

It is obvious that the last is merely a repetition of the one preceding, and that the two before are based on the original specimens collected by Quoy and Gaimard.

Pilsbry relegated all these to an Appendix of insufficiently described species, and then introduced as new:—

"*Onithochiton semisculptus*. Shell oblong, elevated, subangular, dark olive-green, having snowy angular lines and dots on the lateral areas, and

closer, more regular transverse lines on central areas. Surface shining and smooth on the central areas, closely and finely striated radially on the head valve and lateral areas, the striae crowded and subgranose, about 12 in number, on each lateral area. Interior white. Girdle narrow, brown. Length, 27½ mm.; breadth, 16 mm. Divergence about 95°. Habitat unknown. This species resembles the stout, elevated, dark olive forms of *O. undulatus*, such as occur at Auckland, N.Z., in contour and coloration. It differs markedly from *undulatus*, and all other known species in the sculpture of the lateral areas."

Some years later Suter recognised the Chatham Island form as agreeing with Pilsbry's description, and therefore used his name. However, similar shells occur commonly on the mainland, and there is no doubt that this curious variation is not geographic as present material proves. Further, the Rochebrune descriptions particularise the same details as emphasised by Pilsbry.

It is possible that the Chatham Island form may be separable as it is larger and generally shows more distinctly the "*semisculptus*" features. Dimensions: 46 x 25 mm. (Suter).

Dimensions: 35 x 21.

Station: On or under stones between tide marks.

67. *ONITHOCHITON SUBANTARCTICUS*.

(Plate x., fig. 13.)

1907. *Onithochiton undulatus* Quoy and Gaimard, var. *subantarcticus* Suter, Trans. New Zeal. Inst., xxxix., 1906, 268. Auckland Islands. Type in Coll. Suter, now in Wanganui Museum, N.Z.

1909. *Onithochiton undulatus subantarcticus* Suter, Subant Islands, N.Z., i., 4.

1910. *Onithochiton subantarcticus* Iredale, Proc. Mal. Soc., ix., 153.

1913. *Onithochiton undulatus* var. *subantarcticus* Suter, Man. N.Z. Moll., 49.

1915. *Onithochiton subantarcticus* Iredale, Trans. N.Z. Inst., 47, 1914, 426.

1926. *Onithochiton subantarcticus* Finlay, Trans. N.Z. Inst., 57, 335.

Suter only introduced this: "At the Auckland and Campbell Islands there occurs a very constant colour variety, chocolate brown, which certainly deserves a varietal name. Sometimes one or several intermediate valves are transversely banded with white. The girdle is always buff coloured. Type from the Auckland Islands in my collection." In the Manual he still regarded it as a colour variation, adding: "Cook Strait and New Brighton, but rare."

Iredale pointed out that the additional localities were erroneous and referable to a different unnamed species. Finlay collected this latter and also confused it (Trans. N.Z. Inst., 55, 1924, 521), but later corrected this determination and admitted *subantarcticus* as a distinct species.

All the specimens examined are dark coloured, smooth on the lateral areas, no pustules being seen at all, elevated, and the teeth are very short.

68. *ONITHOCHITON OPINIOSUS*, *sp. nov.*

(Plate x., fig. 20.)

Under kelp roots, especially in Otago, in addition to *Frembleya egregia*, and whose characteristic station this is, an *Onithochiton* commonly occurs. It is superficially very different to the common form, as it is very depressed, the valves narrow, and entirely smooth. Ocelli are also very few and scarcely noticeable. The valves are much deeper than those of the common shell, and the insertion-plates are longer, while the sutural

laminae are strongly developed, and internally there is a great formation of callus, apparently to counteract the attacks of some microscopic living animals. This may be an ecologic variant, but offers such distinct features that it is here named.

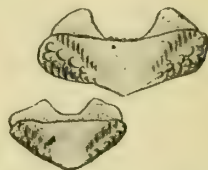
69. ONITHOCHITON MARMORATUS.

(Plate x., fig. 11.)

1904. *Onithochiton marmoratus* Wissel, Zool. Jahrb. Syst., xx., 660, figs. 67-69. New Zealand. Type in Nat. Hist. Mus., Bremen.
1907. *Onithochiton nodosus* Suter, Proc. Mal. Soc., vii., 297, fig. 4 in text. Foveaux Strait, New Zealand. Type in Coll. Sufer, now in Wanganui Museum.
1909. *Onithochiton marmoratus* Suter, Nachr. Blatt. Deutsch. Malak. Gesell., xli., 75.
1910. *Onithochiton marmoratus* Thiele, Revision Chitonen, pt. ii. (Zooligica Chun, heft 56), 99, pl. 10, figs. 64-67.
1913. *Onithochiton nodosus* Suter, Man. N.Z. Moll., 47. Atlas, pl. 5, fig. 4.
1913. *Onithochiton marmoratus* Suter, Man. N.Z. Moll., 1081.
1915. *Onithochiton marmoratus* Iredale, Trans. N.Z. Inst., 47, 1914, 426.
1924. *Onithochiton marmoratus* Odhner, Vidensk. Medd. Dansk. Nat. Foren. Bd., 77 (N.Z. Moll.), 9. North Is.

Suter described an extraordinary little shell as follows: "Shell small, elongately ovate, shining, flesh colour, variegated with white and brown, lateral areas with nodulous ribs. Anterior valve with about 20 radiating nodulous riblets, crossed by four concentric furrows; about 14 radiate rows of minute silvery eyes. Intermediate valves slightly beaked, with the jugum sharply rounded; central areas minutely punctate, with longitudinal ridges in front of the lateral areas, short near the centre, but extending nearly the whole length on approaching the margins; several transverse furrows extend over the central areas and jugum. Lateral areas scarcely raised, with three nodulous ribs, the two posterior ones close together, sutures slightly crenulated; one row of eyes between the first and second rib. Posterior valve with the mucro terminal, minutely punctate, a concentric marginal row of nodules, interspersed with eyes. Girdle narrow, leathery (dry specimen!), with narrow white stripes below the sutures; colour light pink over the jugum, minutely dotted with white, margined by rows of triangular white spots; central and lateral areas reddish brown, variegated with white on some of the intermediate valves. Anterior valve with 10 irregularly spaced slits, teeth pectinate; intermediate valves with one slit on each side; posterior valve with a low, smooth, and rounded callus. Length, 17 mm.; breadth, 7 mm.; divergence, 70°. Habitat: Foveaux Strait in 18 fathoms (one specimen)."

A couple of years later Suter came across and criticised an essay by Wissel, who wrote a paper full of inexcusable blunders, not even placing the species in their right families. Wissel had described an *Onithochiton marmoratus*, and Suter recognised in the description only a colour variation of the variable *O. undulatus*, a conclusion merited by the description. From examination of Wissel's type, however, Thiele was able to show that



Copy of Thiele's figures of type of *O. marmoratus* Wissel.

it was the species described as *nodosus* by Suter. Thiele gave figures supporting this conclusion, and explained that Wissel had not described the sculpture (the only characteristic of the species) amongst other errors. It is unfortunate that such a name should be allowed to take precedence, but Suter acknowledged the identity.

70. ONITHOCHITON OLIVERI.

(Plate x., fig. 17.)

1914. *Onithochiton oliveri* Iredale, Proc. Mal. Soc., xi., 46, pl. ii., fig. 11. Sunday Is., Kermadec Group. Type in Canterbury Museum, Christchurch, New Zealand.

1915. *Onithochiton oliveri* Oliver, Trans. N.Z. Inst., 47, 1914, 558.

Iredale's description is here reprinted: "Shell of medium size, rather broadly oval, slightly keeled, girdle densely spiculose. Coloration variable, dark green with lighter marblings being normal; one small shell is dark chocolate, varied with cream and pink, whilst another is bright vermilion with cream markings. The whole shell is absolutely smooth and glossy, a few growth lines only showing, the lateral areas of the median valves being indicated by a slight elevation. On the anterior valve twenty to twenty-five irregular radiating rows of eyes, about ten eyes to a row, can be counted. On the lateral areas one row, often doubled and trebled, can be noted. Inside coloration pinkish white, the anterior valve with two reddish-brown marks on posterior edge; the first median valve with a large red-brown blotch similarly placed, which is more or less extensive on the succeeding valves, but absent from the posterior valve. Anterior valve with projecting plate regularly eight-slit, the teeth beautifully pectinate. Median valves with large sutural laminae, higher near the sinus, which is clearly denticulate. Insertion-plate one-slit and pectinate. Posterior valve with the insertion-plate reduced to a callus, beyond which the tegmentum extends. Girdle covered with long sharp pointed, glassy spikes. Length of type, 24 mm.; breadth, 15 mm. Habitat: Sunday Island, Kermadec Group. Station: Living in crevices of rocks between tide marks. Remarks: This species is closely related to *Onithochiton filholi* Rochebrune (= *undulatus*, auct.) from which it is at sight separable by the girdle characters. Every specimen found was perfectly smooth, and showed no approach to the ribbing, which caused the '*semisculptus*' confusion in the case of the Neozelanic species."

71. ONITHOCHITON DISCREPANS.

(Plate x., figs. 3-9.)

1912. *Onithochiton discrepans* Hedley and Hull, Proc. Linn. Soc. N.S.W., xxxvii., 280, pl. xiii., fig. 9a, fig. 1. December 13. Lord Howe Island. Type in Australian Museum, Sydney.

The original description is given: "Shell elevated, the dorsal ridge rounded. Colour olive buff, variably flamed with orange, wood-brown and green. The colour of different specimens varies considerably; in some the orange predominates, others are chiefly green. Anterior valve having 8 or 9 radiating ribs, distinctly raised, and concentrically grooved, separating 9 or 10 rows of ocelli; the posterior margin of the valve with smooth thickened ridge. Posterior valve smooth, mucro posterior. Median valves moderately beaked, the lateral areas raised, radially grooved by 4 to 6 furrows; rows of ocelli between the anterior rib and the furrows. Central areas with shallow sulci, originating at and denticulating the anterior rib and vanishing towards the margin. Girdle leathery, two-thirds the width of exposed portion of valves, pale yellow, veined with orange brown;

densely clothed with microscopic down. Interior pearly white; sinus broad, deep, denticulate. Anterior valve having 8 and median valves 1-1 slits. Length, 19 mm.; breadth, 12 mm. Station: In interstices of waterworn fragments of coral rock, or attached to the rocky sides of pools in the reef at low tide. Habitat: Lord Howe Island. Remarks: Compared with the Australian *O. quercinus*, the new species is apparently far smaller. In the median valves of *O. discrepans* the eye rows part radial from transverse ridges, whereas uninterrupted transverse ridges prevail in *O. quercinus*. The anterior valve of the Australian form is concentrically furrowed, but in the Lord Howe Island species radial ridges are dominant."

It may be recorded that in this case the Lord Howe Island shell is quite unlike the Kermadec one, which is closely related to the New Zealand common species, but is more like the Australian subtropical series. The relationships of the species of *Onithochiton* would form an interesting study.

EXPLANATION OF PLATE VII.

- Fig. 1. *Plaxiphora aurata* Spalowsky, whole shell.
 „ 2. *Plaxiphora aurata* Spalowsky, exterior of anterior valve.
 „ 3. *Plaxiphora aurata* Spalowsky, exterior of median valve.
 „ 4. *Plaxiphora aurata* Spalowsky, exterior of posterior valve.
 „ 5. *Plaxiphora aurata* Spalowsky, interior of posterior valve.
 „ 6. *Maorichiton caelatus* Reeve, whole shell.
 „ 7. *Maorichiton lyallensis* Mestayer = juvenile *caelatus* Reeve.
 „ 8. *Maorichiton schauinslandi* Thiele, whole shell.
 „ 9. *Maorichiton mixtus* Iredale, whole shell.
 „ 10. *Maorichiton mixtus* Iredale, exterior of median valve.
 „ 11. *Maorichiton mixtus* Iredale, exterior of posterior valve.
 „ 12. *Maorichiton mixtus* Iredale, interior of posterior valve.
 „ 13. *Vaferichiton murchisoni* Suter, whole shell.
 „ 14. *Vaferichiton murchisoni* Suter, girdle scales.
 „ 15. *Diaphoroplax biramosa* Quoy & Gaimard, whole shell.
 „ 16. *Diaphoroplax biramosa* Quoy & Gaimard, exterior of anterior valve.
 „ 17. *Guildingia obtecta* Pilsbry, whole shell.
 „ 18. *Guildingia obtecta* Pilsbry, exterior of anterior valve.
 „ 19. *Guildingia obtecta* Pilsbry, interior of anterior valve.
 „ 20. *Guildingia obtecta* Pilsbry, exterior of posterior valve.
 „ 21. *Guildingia obtecta* Pilsbry, interior of posterior valve.
 „ 22. *Guildingia obtecta* Pilsbry, exterior of median valve.
 „ 23. *Guildingia obtecta* Pilsbry, interior of median valve.

EXPLANATION OF PLATE VIII.

- Fig. 1. *Frembleya egregia* H. and A. Adams, whole shell.
 „ 2. *Frembleya egregia* H. and A. Adams, exterior of posterior valve.
 „ 3. *Frembleya egregia* H. and A. Adams, interior of posterior valve.
 „ 4. *Frembleya egregia* H. and A. Adams, exterior of median valve.
 „ 5. *Frembleya egregia* H. and A. Adams, interior of median valve.
 „ 6. *Frembleya egregia* H. and A. Adams, exterior of anterior valve.
 „ 7. *Frembleya egregia* H. and A. Adams, interior of anterior valve.
 „ 8. *Frembleya egregia* H. and A. Adams, side view of posterior valve.
 „ 9. *Hemiarthrum hamiltonorum* Iredale & Hull, whole shell.
 „ 10. *Hemiarthrum hamiltonorum* Iredale & Hull, exterior of posterior valve.
 „ 11. *Hemiarthrum hamiltonorum* Iredale & Hull, exterior of anterior valve.

- Fig. 12. *Hemiarthrum hamiltonorum* Iredale & Hull, interior of posterior valve.
 „ 13. *Hemiarthrum hamiltonorum* Iredale & Hull, interior of anterior valve.
 „ 14. *Hemiarthrum hamiltonorum* Iredale & Hull, exterior of median valve.
 „ 15. *Hemiarthrum hamiltonorum* Iredale & Hull, interior of median valve.
 „ 16. *Rhyssoplax aerea* Reeve (juv. = type of *oliveri* Mestayer).
 „ 17. *Tegulaplax howensis* Hedley & Hull, whole shell.
 „ 18. *Tegulaplax howensis* Hedley & Hull, exterior of anterior valve.
 „ 19. *Tegulaplax howensis* Hedley & Hull, exterior of posterior valve.
 „ 20. *Tegulaplax howensis* Hedley & Hull, interior of posterior valve.
 „ 21. *Tegulaplax howensis* Hedley & Hull, interior of anterior valve.
 „ 22. *Tegulaplax howensis* Hedley & Hull, interior of median valve.
 „ 23. *Tegulaplax howensis* Hedley & Hull, exterior of median valve.
 „ 24. *Tegulaplax howensis* Hedley & Hull, girdle scales.
 „ 25. *Rhyssoplax aerea* Reeve, whole shell.
 „ 26. *Rhyssoplax aerea* Reeve, sculpture of median valve (Auckland Islands).
 „ 27. *Rhyssoplax aerea* Reeve, sculpture of median valve (Tauranga).
 „ 28. *Rhyssoplax suteri* Iredale, whole shell.
 „ 29. *Rhyssoplax suteri* Iredale, sculpture of median valve.

EXPLANATION OF PLATE IX.

- Fig. 1. *Amaurochiton glaucus* Gray, whole shell.
 „ 2. *Amaurochiton glaucus* Gray, exterior of anterior valve.
 „ 3. *Amaurochiton glaucus* Gray, interior of anterior valve.
 „ 4. *Amaurochiton glaucus* Gray, exterior of posterior valve.
 „ 5. *Amaurochiton glaucus* Gray, interior of posterior valve.
 „ 6. *Amaurochiton glaucus* Gray, exterior of median valve.
 „ 7. *Amaurochiton glaucus* Gray, interior of median valve.
 „ 8. *Rhyssoplax huttoni* Suter, whole shell.
 „ 9. *Rhyssoplax huttoni* Suter, exterior of half of median valve.
 „ 10. *Rhyssoplax stangeri* Reeve, whole shell.
 „ 11. *Rhyssoplax stangeri* Reeve, exterior of half of median valve.
 „ 12. *Rhyssoplax canaliculata* Quoy & Gaimard, whole shell.
 „ 13. *Rhyssoplax canaliculata* Quoy & Gaimard, exterior of half of median valve.
 „ 14. *Rhyssoplax exasperata* Iredale, whole shell.
 „ 15. *Rhyssoplax whitleyi* Iredale & Hull, whole shell.
 „ 16. *Rhyssoplax whitleyi* Iredale & Hull, exterior of half of median valve.
 „ 17. *Rhyssoplax coryphea* Hedley & Hull, whole shell.
 „ 18. *Rhyssoplax coryphea* Hedley & Hull, exterior of anterior valve.
 „ 19. *Rhyssoplax coryphea* Hedley & Hull, exterior of median valve.
 „ 20. *Rhyssoplax coryphea* Hedley & Hull, posterior valve.
 „ 21. *Sypharochiton pelliserpentis* Quoy & Gaimard, whole shell.

EXPLANATION OF PLATE X.

- Fig. 1. *Sypharochiton sinclairi* Reeve, whole shell.
 „ 2. *Sypharochiton sinclairi* Reeve, girdle scales.
 „ 3. *Onithochiton discrepans* Hedley & Hull, exterior of posterior valve.
 „ 4. *Onithochiton discrepans* Hedley & Hull, exterior of anterior valve.
 „ 5. *Onithochiton discrepans* Hedley & Hull, interior of posterior valve.
 „ 6. *Onithochiton discrepans* Hedley & Hull, exterior of median valve.

- Fig. 7. *Onithochiton discrepans* Hedley & Hull, interior of median valve.
 „ 8. *Onithochiton discrepans* Hedley & Hull, interior of anterior valve.
 „ 9. *Onithochiton discrepans* Hedley & Hull, whole shell.
 „ 10. *Amaurochiton glaucus* Gray, girdle scales.
 „ 11. *Onithochiton marmoratus* Wissel, whole shell.
 „ 12. *Sypharochiton torri* Suter, whole shell.
 „ 13. *Onithochiton subantarcticus* Suter, whole shell.
 „ 14. *Sypharochiton funereus* Hedley & Hull, whole shell.
 „ 15. *Sypharochiton funereus* Hedley & Hull, half of median valve.
 „ 16. *Sypharochiton themeropsis* Iredale, whole shell.
 „ 17. *Onithochiton oliveri* Iredale, whole shell.
 „ 18. *Onithochiton neglectus* Rochebrune, whole shell.
 „ 19. *Onithochiton neglectus* Rochebrune, half of median valve.
 „ 20. *Onithochiton opiniosus* Iredale & Hull, median valve.

BIRDLAND FILMS.

Members who attended the January meeting of the Ornithological Section enjoyed one of the most successful exhibitions of "birdland" films ever placed before them. Mr. Norman Chaffer, who has for several years past been engaged in studying and taking "still" photographs of the Bower-Birds in National Park, has now turned his attention to cinematography, with most gratifying results. Opening with a charming film of the Rufous Fantail feeding a young Square-tailed Cuckoo, he showed a delightful reel in which the foster parents displayed their wonderful activity and the fascinating play of their fanshaped tails, while they fed the clamorous Cuckoo with insects. This was followed by a remarkable film showing the Brown Warbler building its pensile nest, and weaving the webs and bark into the overhanging portico above the entrance. The gem of the evening, however, depicted the Satin Bower-Bird constructing his bower by pressing the sticks into the ground and bending them over at the desired angle; painting them with a brush of stringy bark saturated with pigmented mud; and placing bright objects as ornaments at each entrance to the bower. The day on which the film was taken was rather windy, and the play of light and shade, as the shadows of the gum boughs passed over the bower, produced a remarkably natural effect. As the bright sunlight fell on the glossy plumage of the bird it showed almost a brilliant white in the picture. The whole entertainment was vastly appreciated, and when Mr. Kinghorn displayed a British film depicting the life of the Kestrel, the opinion was unanimously expressed that the local amateur production was equal if not superior to the best of the British professional nature films.

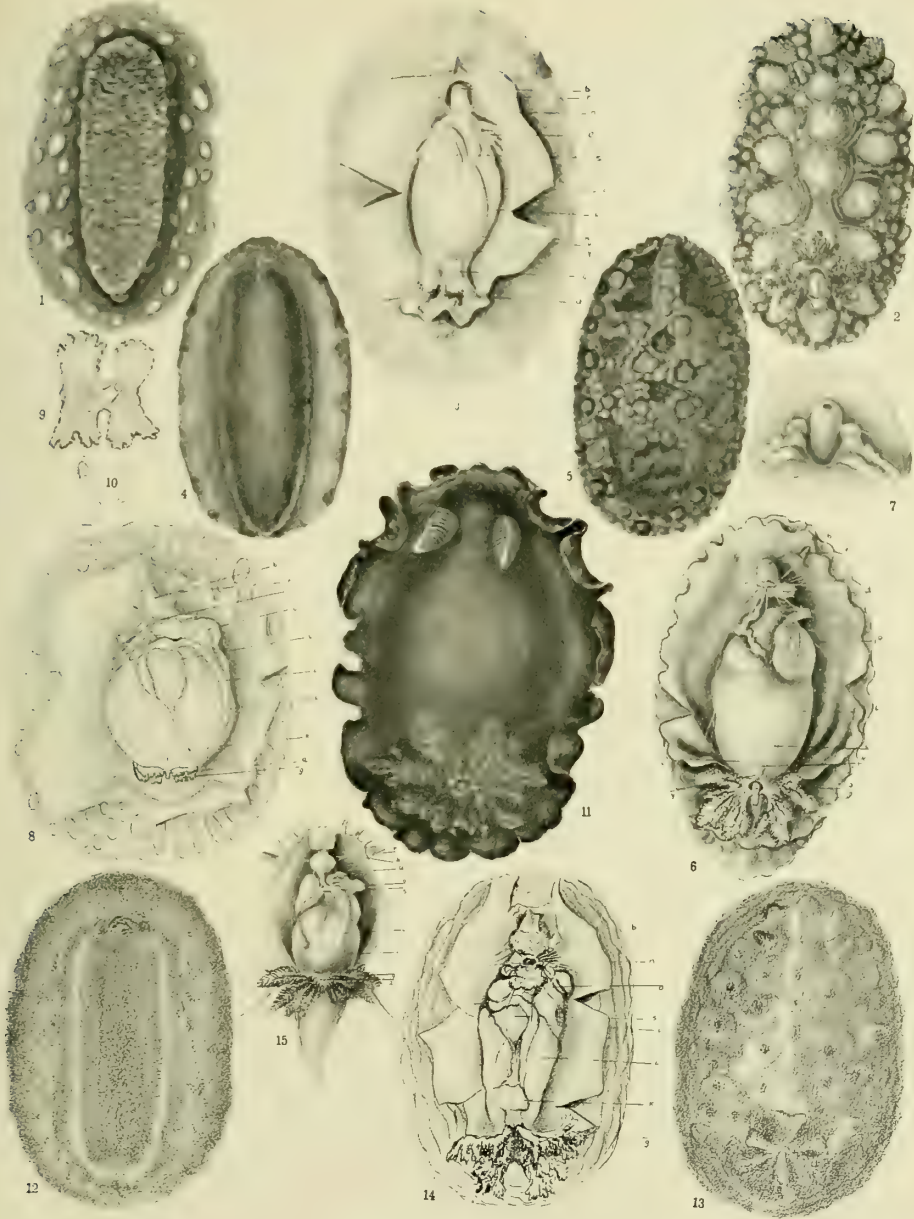
It may be appropriate here to recount an incident in Mr. Chaffer's experience in bird photography. A Melbourne publisher (with a German appellation) of bird "studies" wrote to the section asking for a photograph of the Bower-Bird in its bower for inclusion in a sketch to be published by the writer. Mr. Chaffer very kindly supplied one of his best photographs, but it was returned with the following comments: "I was very disappointed about this photo—a bower-bird, stuffed, also an occasional one, in a bower, perhaps an occasional one, too? That kind of photos. I don't want. . . . I hope that you will understand that I don't like to poke fun at anybody with stuffed birds; for such kind of people my articles are not written."

Possibly the brilliant blue eye of the Bower-Bird, which appears white in a photograph, deceived the casual writer of the letter, but ignorance does not excuse impertinence, although they are often found in conjunction.



Joyce K. Allan, del.

AUSTRALIAN NUDIBRANCHS.

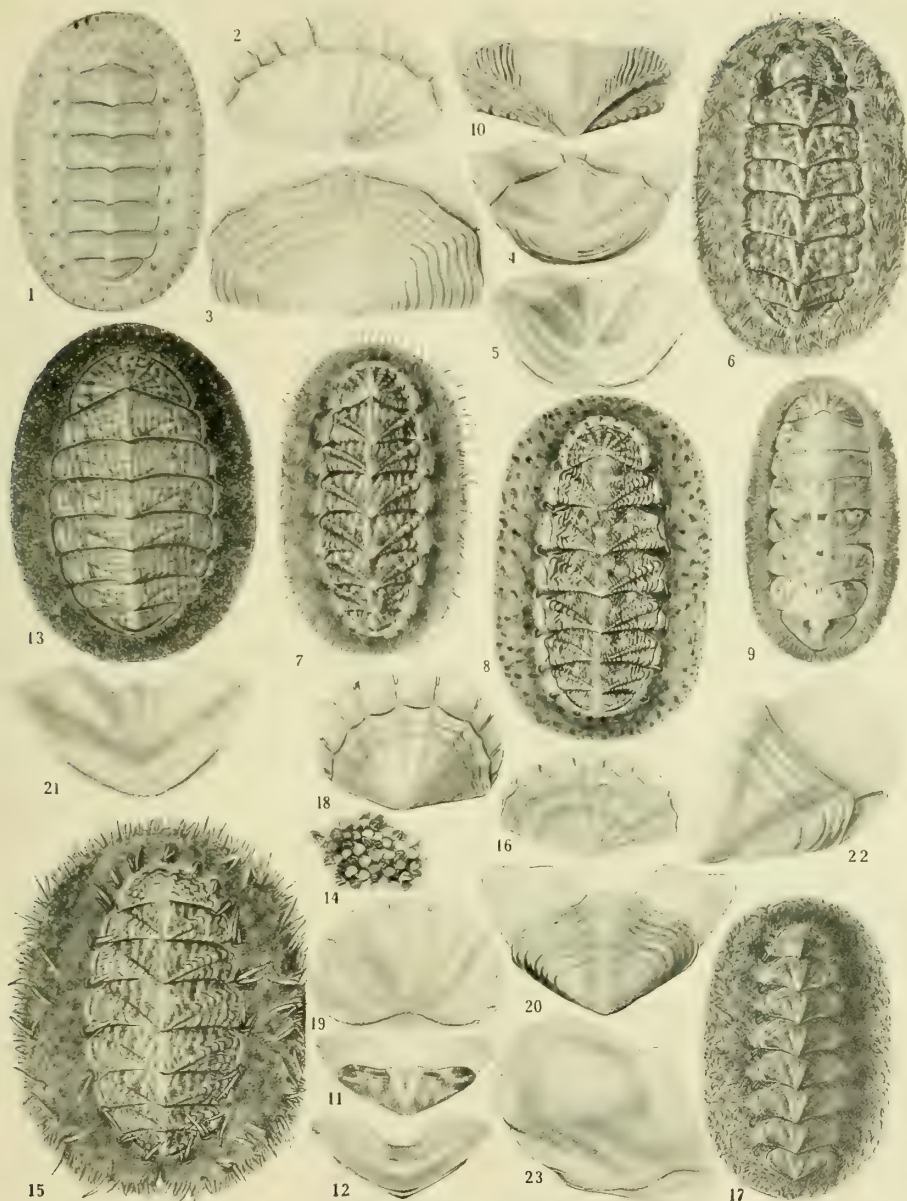


Joyce K. Allan, del.

AUSTRALIAN NUDIBRANCHS.

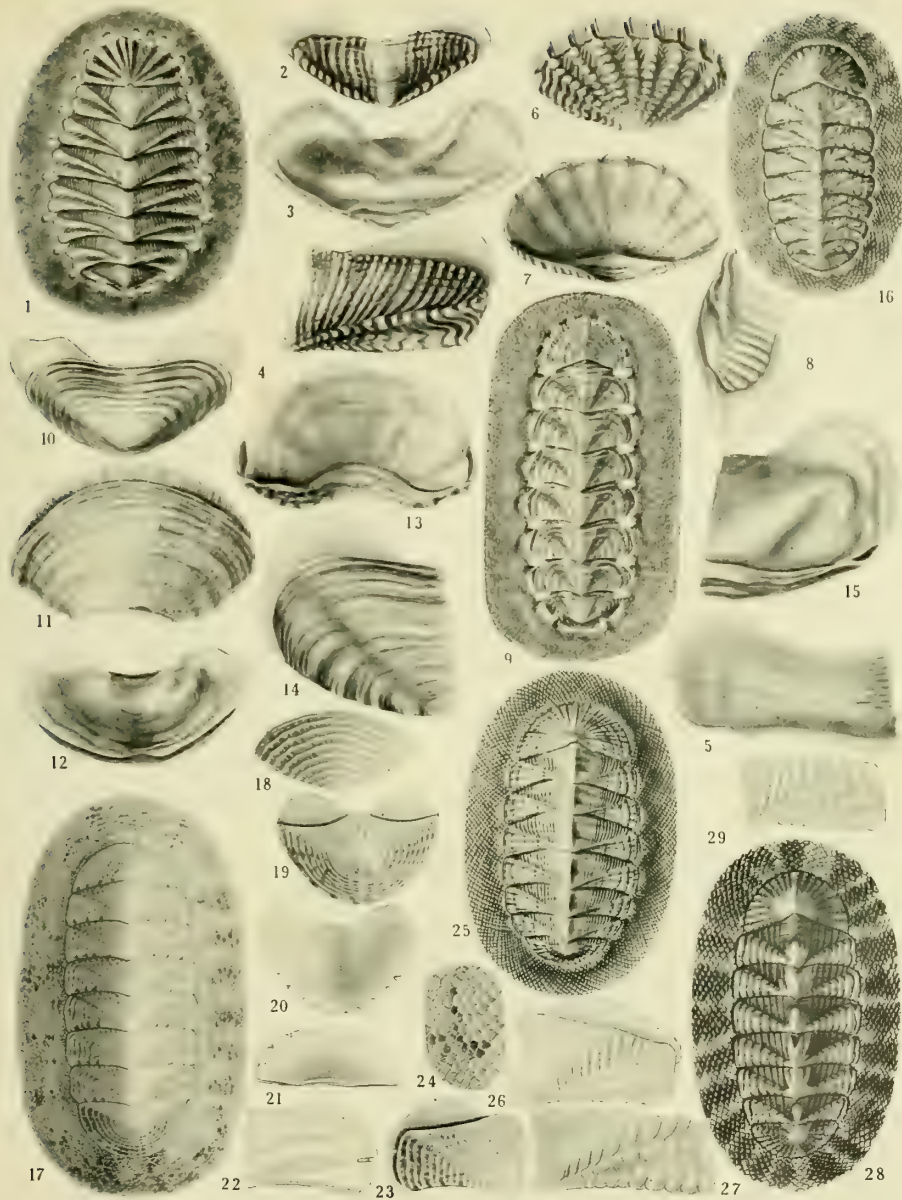


LEADBEATER'S OPOSSUM. *Gymnobelideus leadbeateri*.



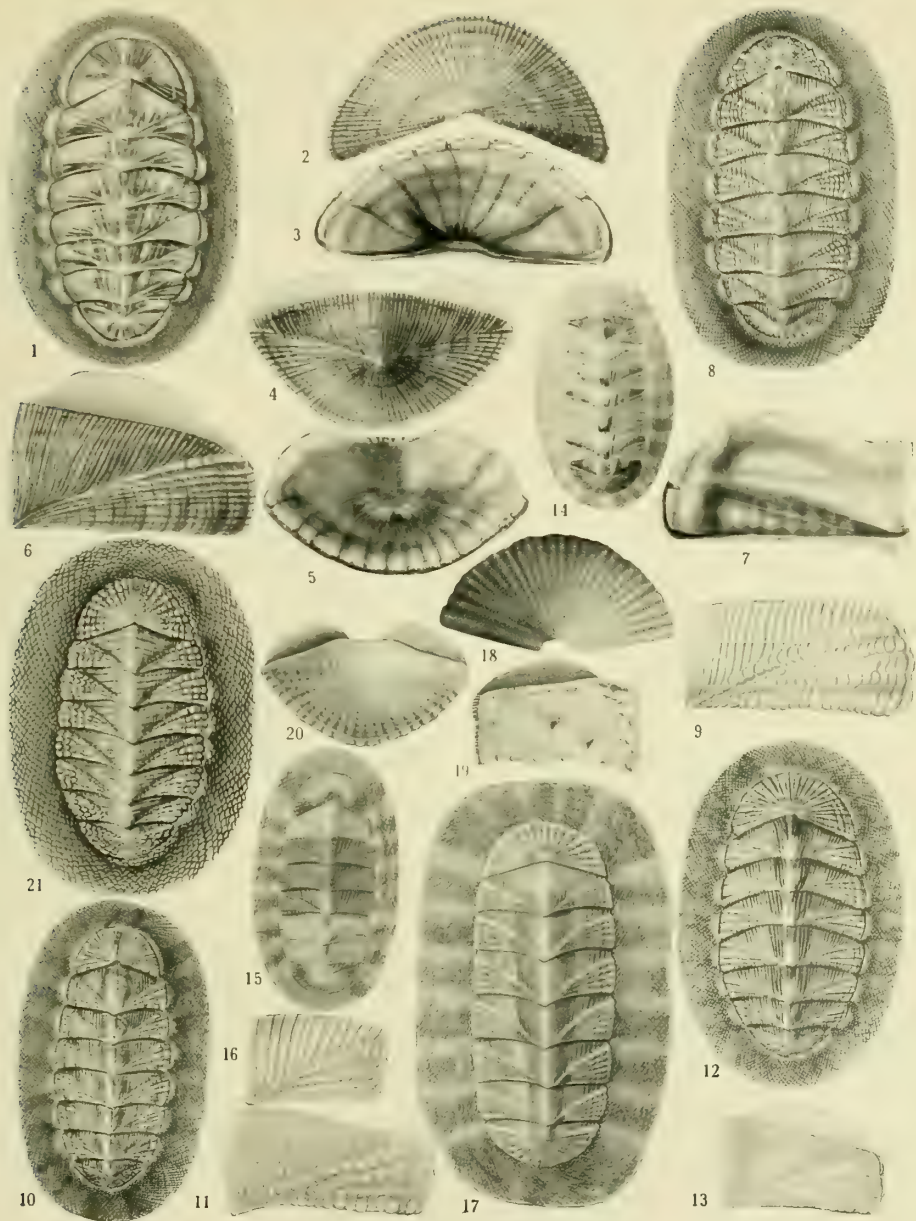
NEOZELANIC LORICATES.

Joyce K. Allan, del.



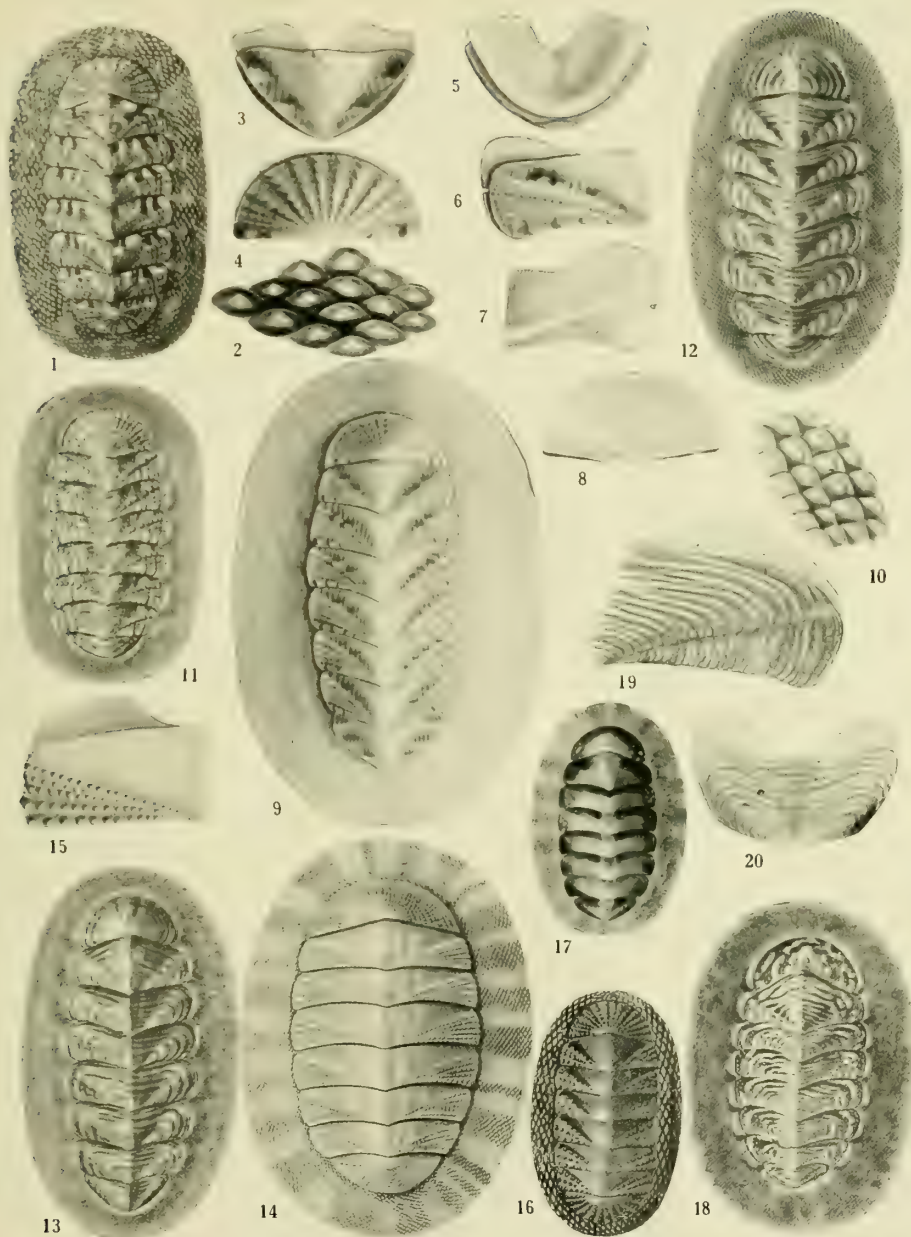
NEOZELANIC LORICATES.

Joyce K. Allan and Phyllis Clarke, del.



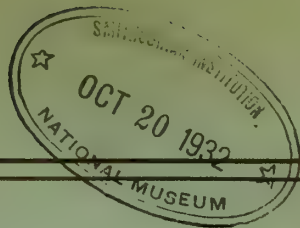
NEOZELANIC LORICATES.

Joyce K. Allan and Phyllis Clarke, del.



NEOZELANIC LORICATES.

Joyce K. Allan and Phyllis Clarke, del.



THE AUSTRALIAN ZOOLOGIST

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Edited by
A. F. BASSET HULL, C.F.A.O.U., F.R.Z.S.

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Royal Zoological Society of New South Wales.

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REGISTERED UNDER THE COMPANIES ACT, 1899 (1917).

Patron:

His Excellency Sir Philip Woolcott Game, G.B.E., K.C.B., D.S.O.

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Royal Zoological Society of New South Wales

THE ANNUAL MEETING, 1931-32.

The fifty-third annual meeting of the Society was held at Science House, Sydney, on Friday, 29th July, 1932, at 8 p.m. His Excellency the Governor (Sir Philip Game), Patron of the Society, the Hon. Frank Chaffey, Chief Secretary, and 112 members and visitors were present. The Honorary Secretary (Mr. Basset Hull) read the

FIFTY-SECOND ANNUAL REPORT.

Members.

On 30th June, 1932, there were 498 members on the register, divided into the various categories, as follows: Associate benefactors 4, life members 25, ordinary members 279, honorary members 6, honorary associates 5, life associates 24, associates 155. Five members died during the year, 34 resigned, and the names of 15 were removed from the register under Article 9. 45 new members and associates were elected, leaving a net reduction of 9, as compared with 1930-31. The depression may again be assigned as the cause of the reduction, and it may also be stated here that the subscriptions of 55 members and associates are in arrears, and it will probably be necessary to remove most of them from the register during the current year.

The Council.

The vacancy caused by the resignation of Mr. David G. Stead at the end of the previous financial year was filled by the election of Mr. Tom Iredale. Ten meetings of the Council were held during the year, the average attendance at which was 14.6 members.

Sections.

The interest in the work of the sections is increasing to such an extent that the Society's room is frequently filled to overflowing, so much so, indeed, that it is proposed to make arrangements for meetings in a larger room in future. The sectional reports, which will appear in *The Australian Zoologist*, set out in detail the work accomplished during the year.

Finances.

Owing to the continued depression, the Society's funds have not increased at the rate shown in previous years. The usual donation of the Walter and Eliza Hall Trust has been suspended for the present, and the considerable arrears in membership subscriptions have had a marked effect on the receipts. However, the balance sheet shows a satisfactory accumulation of assets.

Publications.

Two parts of *The Australian Zoologist* were issued, the papers presented being of standard merit and interest.

Mr. Anthony Musgrave has completed the manuscript of a *Biography of Australian Entomological Literature*, and the Council decided to undertake its publication. Application was made to certain scientific institu-

tions in Australia for contributions to the cost of the work. Several promises have been made in response, and the Trustees of the Australian Museum have contributed £25. With a view to meeting the cost of printing this work, £200 (face value) of consolidated stock was converted into cash, and is now available for the purpose. It was felt that the work is too technical to be a charge on the Handbook Publication Fund, and it will therefore be paid for partly by drawing upon the general account, and partly by donations from other institutions or Societies.

Fellows.

The title of "Fellow" was conferred by the Council on four members in recognition of their distinguished services to Australian Zoology; they were as follows: Harry Burrell, C.M.Z.S., whose researches and studies of the life-history and habits of the Platypus are of outstanding interest and value.

Neville W. Cayley, M.B.O.U., the artist and author of *What Bird is That*, a guide to the Birds of Australia and one of the most comprehensive handbooks ever issued in respect of the avifauna of any country.

William John Dakin, D.Sc., Professor of Zoology, University of Sydney, whose contributions to the knowledge of marine forms, and particularly the plankton, have received world-wide acceptance.

Gustavus Athol Waterhouse, D.Sc., whose monumental volume (in conjunction with George Lyell) on Australian Butterflies is the standard work on the subject.

By resolution, the Council has decided that the number of Fellows to be elected shall not exceed four in any one year.

Fauna Protection.

Earnest consideration has been given to the various phases of fauna protection which arise from time to time, such as the desirability for limitation of open seasons for certain furred animals, the total protection of rarer forms, and the restriction of permits for the collection of protected species. In the face of representations made by interested parties that certain animals are a menace or a pest, or that the unemployed will benefit from their slaughter, it is becoming increasingly difficult to check the unregulated and indiscriminate killing of females bearing young in their pouches.

Wianamatta Shale Country.

In the Counties of Cumberland and Camden, within easy reach of the metropolis, there are some areas of land upon which the vegetation peculiar to the Wianamatta shale still flourishes. The Society is making inquiries as to the possibility of preserving some of these areas in their natural state, as there is a fauna which frequents this vegetation almost exclusively, and which would disappear if its food supply were destroyed by clearing. The Department of Lands is rendering the Society valuable aid in the work of locating suitable areas for reservation.

Taronga Park.

The Trustees have kindly conceded a reversion to the former practice of recognising the "extra" tickets issued to members without limitation as to their period of validity. This is granted experimentally for one year, and members may therefore use any 1931-32 tickets left over during the whole of the 1932-33 year.

In the absence of Mr. Phillip Shipway, Honorary Treasurer, the Honorary Secretary presented the balance sheet.

The Governor Moves Adoption of Report.

His Excellency the Governor moved the adoption of the annual report and balance sheet. He said he was still acutely conscious of his ignorance of matters zoological, and admitted having looked up "Zoology" in the Encyclopaedia. Here he found that his old friend Aristotle was mentioned as one of the earliest zoologists. There was no mention of Noah, although it was obvious that the preservation of so many different species of animals from the flood argued at least an elementary knowledge of the subject. He referred to the handicap imposed on the general reader by the use of technical scientific terms, and suggested that scientists might put their knowledge into simpler language. A great deal had been done by books on popular science, but much remained to be done. He thanked those who had taken to heart his remarks at the previous annual meeting, and had given instructive zoological talks to the Boy Scouts. In this connection he especially mentioned the work of Mr. Clifford Coles. In conclusion, he congratulated the Society on its fifty-three years of honourable and honorary work.

Colonel Alfred Spain, chairman of Taronga Park Trust, seconded the motion, and extended his congratulations to the Society, especially for having kept its finances in such a satisfactory position in a period of depression.

Presidential Address.

The President (Mr. E. L. Troughton), then delivered his address on "Australian Furred Animals: Their Past, Present, and Future."

The Hon. Frank Chaffey, Chief Secretary, moved a vote of thanks to the President for his address, and referred to the necessity for maintaining a balance between the demands of the fauna protectionists, and the man on the land, who had to make his bread and butter out of his holding and could not be expected to regard predatory marsupials as objects of interest to be treated kindly. However, so long as he held office he would see that no general open seasons were proclaimed, and that the destruction of animals would be kept within bounds. He regretted the gradual disappearance of the Native Bear, and other bush friends, and congratulated the Society on the splendid service it was rendering the community.

Death of Miss Hume-Barbour.

On the day our annual meeting was held, Miss Emily Hume-Barbour, our first Associate Benefactor, passed away. It was at the Jubilee of the Society function in March, 1929, that Miss Hume-Barbour suggested the formation of a Women's Auxiliary in connection with the Handbook Publication Fund. She subsequently organised the auxiliary, and was its first president, a position she subsequently vacated in favour of Mrs. Norman Lowe. Her donation of one hundred guineas to the Handbook Fund was recognised by the Council conferring upon her the title of Associate Benefactor. Her interest in literary and scientific societies was evidenced by generous donations to their funds.

ROYAL ZOOLOGICAL SOCIETY OF NEW SOUTH WALES.

BALANCE SHEET AS AT 30th JUNE, 1932.

LIABILITIES.				ASSETS.			
	£	s.	d.		£	s.	d.
General Account—				General Capital Account—			
Capital:—				Australian Consolidated Inscribed Stock .	410	0	0
Balance at 30th June, 1931 ..	1,391	5	0	Office Furniture and Equipment (at Valuation)	100	0	0
Add Investment	10	0	0	Library (at Valuation) ..	500	0	0
Adjustment to face value on conversion of Inscribed Stock	8	15	0				1,010 0 0
	1,410	0	0	General Income Account—			
Less Transfer to General Income Account, £200: Hand Book Capital Account, £200	400	0	0	C'th Bank	15	9	0
	1,010	0	0	C'th Savs. Bank Balance as per Pass Book, £231/2/5: Less Outstanding			
Income	270	7	10	Cheque, £2/12/-	228	10	5
	1,280	7	10	Cash on Hand ..	16	18	11
Hand Book Account—				Cheques held to be re-presented	9	9	6
Capital:—							270 7 10
Balance at 30th June, 1931 ..	799	7	6	Hand Book Fund Capital Account—			
Add Adjustment to face value on conversion of Inscribed Stock	12	6		Australian Consolidated Inscribed Stock .	250	0	0
	800	0	0	Australian Consolidated Treasury Bonds ..	750	0	0
Transfer from General Capital Account .	200	0	0	Including:—			1,000 0 0
	1,000	0	0	Albert Littlejohn Endowment ..	100	0	0
Income	95	13	1	Hume - Barbour Endowment ..	106	0	0
	1,095	13	1	Walter & E. Hall Endowment ..	160	0	0
				Hand Book Fund Income Account—			
				C'th Savs. Bank	94	19	6
				Cash on Hand ..	13	7	
							95 13 1
							£2,376 0 11
							£2,376 0 11

HAND BOOK FUND INCOME ACCOUNT. Twelve Months ended 30th June, 1932.

RECEIPTS.				DISBURSEMENTS.			
	£	s.	d.		£	s.	d.
To Balance at 30th June, 1931—				By Balance at 30th June, 1932—			
.. Govt. Savings				.. Commonwealth Savings Bank	94	19	6
.. Bank of N.S.W.	47	9	5	Cash on Hand ..	13	7	
.. Cash on Hand ..	13	19	4				95 13 1
.. Hand Book Sales			61 8 9				
.. Surplus on Bond Conversion ..			4 8 11				
.. Interest on Investments			4 9 3				
			25 6 2				
			£95 13 1				£95 13 1

GENERAL INCOME ACCOUNT.
Twelve Months ended 30th June, 1932.

RECEIPTS.			DISBURSEMENTS.		
	£	s. d.		£	s. d.
To Balance at 30th June, 1931—			By Publication		
.. Government Savings Bank ..	43	8 11	"Australian Zoologist"		
.. Less Overdraft Commonwealth Bank ..	31	0 1	(Vol. 7, Parts 1 and 2)—		
		12 8 10	.. Printing ..	148	19 3
.. Subscriptions —			.. Blocks ..	45	5 2
Annual ..	322	7 0	.. Postage and Delivery ..	7	12 5
.. Subscriptions —					201 16 10
Life ..	11	5 0	.. Office Rent ..		100 0 0
		333 12 0	.. Office Printing and Stationery ..		14 6 4
.. Sales "Australian Zoologist" ..		7 16 6	.. Exchange and Bank Fees ..		6 0 0
.. Rent of Office ..		25 5 0	.. Repairs to Episcopes ..		1 18 6
.. Interest on Investments ..		45 13 5	.. Expenses Meetings, Annual, etc.		7 16 0
.. Bank Exchange and Postage ..		15 5	.. Gas and Electricity ..		6 11 9
.. Surplus on Bond Conversions ..		21 18 9	.. Library Books ..		18 6
.. Sale of Bonds (f.v., £200) ..		189 0 0	.. Book Cases ..		15 13 0
.. Sundries ..		11 6	.. Telephone Charges ..		13 15 0
.. Donations:			.. Post Office Box Fee ..		1 0 0
Australian Museum —towards cost of publishing Anthony Musgrave's Bibliography of Australian Entomological Literature ..	25	0 0	.. Insurance Premiums ..		2 12 0
Harry Burrell ..	5	5 0	.. Postages and Freights ..		15 9 8
		30 5 0	.. Stamp Duty Lease ..		1 0 0
			.. Advertising ..		2 0 0
			.. Sundries ..		1 10 0
			.. Investment—Consolidated Inscribed Stock ..		10 0 0
			.. Balance at 30th June, 1932—		
			.. C'th Bank ..	15	9 0
			.. Commonwealth Savings Bank ..	228	10 5
			.. Cash on Hand ..	16	18 11
			.. Cheques to be represented ..	9	9 6
					270 7 10
		£667 6 5			£667 6 5

I have examined the books and vouchers of the Royal Zoological Society of New South Wales for the twelve months ended 30th June, 1932, and certify that the above Balance Sheet and accompanying Statements are properly drawn up so as to exhibit a true and correct view of the state of the Society's affairs as at 30th June, 1932, and the transactions for the year ended that date respectively, as disclosed by the books of the Society and information supplied.

Sydney, 20th July, 1932.

ROBT. J. STIFFE, F.C.A. (Aust.),
Hon. Auditor.

PHILLIP SHIPWAY,
Hon. Treasurer.

REPORTS OF SECTIONS.

Marine Zoological Section.

(Read 7th June, 1932.)

To-night marks the close of the Marine Section's sixth year. It has been a year of activity and steady progress in the interests of marine science in this State.

Despite the depressing times, members have maintained steady interest in the work of the Section. The attendance at meetings has been much more consistent and satisfactory than during last year.

By far the most important work of the members has been centred in the elaboration and completion of the proposed marine handbook of our local shore. A meeting of a committee from the Council and representatives from our Section has recently taken place to discuss the final stages of the work and co-ordination of the MSS. and illustrations. It is confidently hoped that the volume will be in the printer's hands very shortly.

During the year two successful field excursions were organised—one to the Bottle and Glass Rocks, and the other to Pussy Cat Bay, near La Perouse. The need for excursions such as these has been long felt by members, and it is anticipated that the activities of the coming year will include further outings of this kind.

As previously, lantern lectures have been an important feature of the monthly meetings. The syllabus for the year just closed embraces a series of lectures, which have maintained the standard and provided the members at once with instruction and entertainment. A list of the lectures given is appended.

3rd August.—"Crab-hunting on the North Coast," by Mr. J. R. Kinghorn.

7th September.—"Shells," by Mr. Tom Iredale.

6th October.—"Aquarium Observations," by Mr. A. S. Le Souef. "Animal Associations," by Mr. W. Boardman.

2nd November.—"Sea Slugs (Nudibranchia)," by Miss Joyce K. Allan.

7th December.—"Rarotonga," by Mr. G. P. Whitley.

1st February.—"Lord Howe Island," by Mr. A. Musgrave.

7th March.—"Nor-west Islet, Capricorn Group," by Messrs. A. Musgrave and F. A. McNeill.

2nd May.—"Sea Snakes," by Mr. J. R. Kinghorn.

G. P. WHITLEY, Chairman.

W. BOARDMAN, Secretary.

Ornithological Section.

During the session ended, the attendances have been maintained and there has been no lack of interest in the proceedings. Before dealing with the routine events of the season, two outstanding items must be emphasised as indicative of the energy and quality of our members.

Mr. Neville Cayley, our enthusiastic secretary, has published a bird book, entitled, "What Bird Is That?" This book is almost unique, in that it was planned and carried out entirely by the artist-author, who prepared the plates from his own designs and saw the whole through the press. It achieved a phenomenal sale, proving that it filled a want, and has been favourably reviewed by ornithologists all over the world. The parent Society has enrolled Mr. Cayley among its list of Fellows, making the third from this Section to achieve that high honour, the total number of Fellows being only ten. We congratulate Mr. Cayley, and the Section must be proud of his success.

Mr. Alec H. Chisholm followed his previous successes with another book, entitled, "Nature Fantasy in Australia," but mainly dealing with the flora, fauna, and geology of Sydney-side. This book, written in his delightful literary style, has received acclamation everywhere, and our familiar friend has been compared with those great classical writers of bird literature, W. H. Hudson, Burroughs, and Gilbert White. Our congratulations are again well merited, and further gems are anticipated. Again, before passing on, we may note the progress of the Avicultural Section, a companion to our own, and whose inception was mainly due to the initiative of our Secretary, Mr. Cayley. We may anticipate that Mr. Cayley has in the press a book dealing with Australian finches, both in the wilds and in the aviary. As contributors to *The Emu*, *Australian Museum Magazine*, etc., Messrs. Hindwood, Marshall and others have continued with healthy essays, the former with his historical account of the Emu Wren, furnishing an essay comparing more than favourably with any published in any part of the world. Mr. Marshall, one of the youngest of our senior members, has been exploring the wilds of mid-Queensland searching for lost birds and accumulating knowledge which will later prove very valuable to him and to this Society.

Our photographers have been by no means idle, Mr. Norman Chaffer taking up cinema photography, and advised by one of our veteran photographers, Mr. J. S. P. Ramsay, producing pictorial results equal to the world's best.

We had the pleasure of the attendance of members of the American Harvard Expedition, and were able to provide a good evening, so that we were complimented upon our activity.

As a matter of fact, we can look back upon the season's work with great satisfaction, and look forward to improving upon a great record.

The meetings may be epitomised thus:—

July 17th, 1931.—Mr. P. A. Gilbert, "Birds of Eastern N.S.W."; their migratory movements and nesting habits, illustrated with his own lantern slides.

August 21st.—The American scientists, Dr. Glover M. Allen, Dr. Philip J. Darlington and Mr. Ralph Ellis, junior, were welcomed, and paintings were exhibited by Mr. E. Gostelow and Mr. N. W. Cayley; lantern slides were shown and lecturettes were given by Messrs. P. A. Gilbert, K. A. Hindwood, J. R. Kinghorn, and A. J. Marshall, dealing with the fauna they might meet with.

September 18th.—Mr. N. W. Cayley, "Owls," illustrated with his paintings of all the Australian species. A discussion on owl-calls ensued and some vivid imitations, notably one of the Powerful Owl, by Mr. K. A. Hindwood were rendered. The untimely death of Mr. B. C. J. Bettington was regretfully recorded.

October 16th.—Mr. M. S. R. Sharland, "Birds of Tasmania and Victoria," with unexcelled lantern slides. Welcome back to Mr. E. J. Bryce from his world tour.

November 20th.—Mr. E. J. Bryce, "Through Persia and the Caucasus," illustrated with lantern slides, a delightful account.

December 18th.—Mr. A. J. Marshall, "Denizens of the Bush," illustrated with lantern slides.

January 15th, 1932.—Mr. Norman Chaffer exhibited motion pictures of Rufous Fantail, Satin Bower Bird and Brown Warbler. Mr. J. R. Kinghorn showed an English motion picture of the life of the Kestrel for comparison.

February 19th.—Mr. J. S. P. Ramsay showed his excellent series of motion pictures of many species, and Mr. N. Chaffer continued with an excellent motion study of the female Regent Bower Bird at nest and young. This meeting acclaimed the exhibitors for their brilliant successes in this difficult branch of photography.

March 18th.—Mr. P. E. B. Barnett showed us the spiders of the district by means of beautiful lantern slides.

April 15th.—Mr. E. J. Bryce, "The Land of the Incas," an excellent account with beautiful pictures.

May 20th.—Mr. N. W. Cayley, "Bird Talk," with a very fine series of lantern slides from photographs taken by Messrs. R. T. Littlejohns, the Hervey Brothers, Otho Webb, F. C. Morse, and D. Gaukrodger. Master Frank Clark gave delightful imitations of the calls of well-known birds.

Owing to his intensive work on his book, Mr. N. W. Cayley was given leave of absence from his secretarial duties for six months, and these were carried out by Mr. C. Coles, to whom our thanks are here tendered.

TOM IREDALE, Chairman.

Avicultural Section.

I have much pleasure in submitting a resume of the activities of the Avicultural Section for the past 12 months.

During the year the regular monthly meetings were well attended, and it was gratifying to see many new faces at our meetings. The average attendance was 20, and your executive urges you to make the existence of this Society known to your bird-loving friends, invite them to one of our meetings and see if we cannot double the membership during the coming year.

The matter of procuring birds for our members was fully discussed, and it was thought that it would be possible to obtain a quantity of birds through the Society for distribution amongst members on a pool system on the understanding that the birds are not to be offered for sale, and that the requirements of each member were not to exceed three pairs of any one variety.

Recognising the increasing popularity of the Budgerigar as a cage bird, a suggestion was made to the Royal Agricultural Society to include classes for the newer coloured varieties in their show schedule for the Easter Show in order that the public be given an opportunity of seeing these beautiful birds. The suggestion was accepted, six classes were provided and accounted for the exhibition of 48 birds, which were greatly admired by all.

The Hon. Chief Secretary was requested to allow members of this Society to obtain a limited number of wild green Budgerigars to infuse strength and stamina into the stock held by members who are endeavouring to produce new colour phases of Budgerigars, and he replied, stating that if the Society applied for a license to obtain birds for this purpose it would receive favourable consideration.

In closing the year, your executive wishes to place on record its sincere thanks to the following gentlemen, who, on several occasions, brightened the meetings by very interesting and educational lectures, which were at all times appreciated—Messrs. J. Ward, J. R. Kinghorn, E. Le G. Troughton, Neville Cayley, C. Coles, A. J. Marshall, and N. Chaffer.

I believe that the Avicultural Section will grow by leaps and bounds, and that the membership will have more than doubled itself by the next annual meeting.

E. W. JONES, Hon. Secretary.

AUSTRALIAN FURRED ANIMALS, THEIR PAST, PRESENT, AND FUTURE.

PRESIDENTIAL ADDRESS.

BY ELLIS LE G. TROUGHTON, Mammalogist, the Australian Museum.

Although it is just over three centuries since the Dutch navigator Pelsart provided the first authentic description of an Australian marsupial, this is probably the first occasion upon which a mammalogist, one devoted to the study of furred animals alone, has occupied the Presidential Chair of an Australian society. It is fitting therefore that my address should deal with the fascinating subject of mammalogy, the only diffidence being not that the subject should prove unattractive, but that one might fail to do justice to its manifold interests. The romantic history of the discovery, settlement, and exploration of our continent has been associated page by page with the discovery of unique kinds of mammals which proved a source of wonderment, controversy, and inspiration to Cuvier, Owen, Huxley, and such giants of the scientific world. The basic reason of this absorbing interest is the fact that geological isolation since prehistoric times constituted Australia both a cradle and preserve of marsupial life, which it is a national duty to uphold as a sanctuary for all time. Alas, the task is as difficult as it is worthy, for by an irony of natural law, past security, which permitted the slow and varied development of marsupials, now leaves them unable to cope with changed conditions and naked to their introduced enemies.

The evolution of our furred fauna may be divided into three very unequal periods—that prior to man's advent, the early aboriginal, and the white occupation. The aim of this address is briefly to review the fascinating scope of mammalian research, point out the drastic changes wrought during the brief period of occupation by the cultured whites—which is as a clock beat in antiquity—and to ask the vital question, what are we doing towards adequate conservation and study of this heritage from the ages. A natural, if possibly somewhat superfluous preliminary, is to define what a mammal really is.

In the choice of lecture titles one is struck with the thought that terms such as mammal, or mammalogy, appear technical and unattractive when applied to so delightful a study, yet they are essential to separate the furred from the feathered and lowlier vertebrates. For example, we have Birds and Animal Protection Acts, but the term animal includes birds and all zoological life, from jelly-like organisms oozing an almost senseless way through slimy haunts, to man himself. The term mammal serves to distinguish furred animals from the animal kingdom as a whole, and is derived from the mammae or milk-glands associated with the suckling of the young, a universal characteristic of all furred animals, or those once covered with hair, such as whales and elephants. It is this habit, apart from the furry covering, which strikingly emphasises the distinction between the egg-laying platypus and the egg-laying reptilia from which the primeval origin of all mammals is traceable. Breathing the atmospheric air as we humans do, at no stage of life do mammals develop functional gills, which is significant when one considers that whales and dolphins, once regarded as fishes, are actually descended from land mammals of the geological long ago, which are adapted for a seafaring existence. Most of you are familiar with the old woodcuts depicting a whale spouting like a garden hose in mid-summer, but the "spout" of whales is really the condensation of heated air, like one's breath on a frosty morning.

The warm-blooded character of mammals may be emphasised also by comparison with whales, the young of which show traces of the hairy covering which nature replaces with a thick eiderdown of blubber to act as a non-conductor of heat and cold, thus retaining the body-warmth, a provision quite unnecessary for the cold-blooded fishes. It is not necessary to stress the matter, beyond the illustration of mammalian characteristics, and, anyway, London "Punch" said the last word on the distinction between whale and fish in a pithy little rhyme:—

And this is what punctures the bubble,
As Jonah, no doubt, was aware,
"A fish" was the cause of the trouble,
But a whale is a mammal, so there.

While the basic skeletal structure and anatomical features are common to all mammals, an amazing variety of forms has evolved in the course of adaptation to specialised habits and environment. Nature, like a musician, has taken a single elementary theme and woven endless variations, yet preserving an unmistakable unity or motif throughout all the changes. Thus are grouped in the Class Mammalia—the egg-laying platypus and spiny ant-eaters, the marsupials of Australia and America, rodents such as the tiny mice and house-building beavers, the whales, some of which attain a length of a hundred feet and live on tiny crustaceans sieved from the sea by the whalebone-fringes, hoofed grass-eaters represented by such oddities as giraffes, elephants, and the homely Hippo—and their domesticated cousins, sheep, cattle, and horses; then there are the flesh-eaters such as cats and bears, the fish-eating seals, and, lastly, bats, monkeys, apes, and man.

Of some fourteen orders of living mammals, of which the majority are listed above, but four—the egg-laying monotremes, marsupials, mice and rats, and bats inhabited this continent prior to man; the mammals now present may therefore be divided into the kinds which existed long before white men arrived to harry them with poison, gun, and trap, and those transported by man's agency. Everyone becomes so used to thinking of Australia as the land of marsupials, that they are apt to overlook the fact that there are scores of non-marsupial species indigenous to our continent. Man brought with him the two plague-carrying rats, and the house-mouse, but Australia already possessed over fifty species of mice and rats, most of which are living to-day. Some of these rodents are quaintly shaped, with large ears, long kangaroo-like feet and bushy-tails, while others have thickened tails associated with the storage of fat against lean seasons. One species has the peculiar habit of building a strong stick-nest several feet high, interwoven with the trunk and limbs of small trees, as a protection from its enemies. There are also over fifty species of bats, of which the fruit-bats, or "flying-foxes" as they are inappropriately called, are pests in orchards. Against these half dozen large fruit-eating species there are about forty small insectivorous ones which consume myriads of harmful insects and are thus man's ally, taking the night watch in the avian battle against insect pests.

The Prehistoric Invasion of Mammalian Stock.

It has been said that the little "up side-down" bats were masters of the air long before man walked upright, and, as their flight may be as facile and sustained as that of many birds, their introduction needs no explanation. Ages before man's appearance in Australia, however, nature wove her complex marsupial pattern from primitive earth-bound stock, in

a splendid isolation which has rendered their means of introduction the subject of controversy between rival factions favouring either an early southern land connection with South America, or a series of discontinuous land bridges linking up with Asia. It is not possible to deal here with the relative merits of theories so ably summarised by my chief, Dr. Charles Anderson, M.A., in his Presidential Address to the Royal Society of New South Wales in 1925, which made it clear that the question must remain in doubt pending the discovery of some common ancestral form in the fossil beds of Asia or Antarctica. It is evident, however, that such land bridges, even if discontinuous, could not have permitted the free passage of marsupials and acted as a barrier to other types of grass or flesh-eating mammals, unless the land mammals of the outer world had consisted entirely of marsupial progenitors at the time of invasion.

The possibility of introduction across narrow straits by means of floating debris must not be overlooked in regard to the small and probably arboreal marsupials. As Dr. Anderson pointed out, it is generally supposed that the indigenous rats and mice (*Muridae*) entered in this manner, adding that our late colleague, Allan R. McCulloch, had informed him that floating islands of vegetation were frequently seen when travelling with Captain Hurley in the vicinity of the Fly River estuary of Papua. The latter observation is significant regarding invasion from the north, as the numerous islands and cays in Torres Strait harbour species of mosaic-tailed mice (*Melomys*) which are inter-related generically with southern New Guinea and northern mainland forms, and are barely distinguishable specifically by mere coloration; it seems evident, as Bensley suggested, that the marsupials may have entered in a similar way, by means of natural rafts and intermediate insular stages. Finally, it is notable that the mammalian fauna of New Zealand, separated by much greater distances from other land masses, consisted of but two species of bats, apart from the small Pacific islands' rat, obviously introduced in the vessels of the intrepid Polynesians, and a small dog brought either by the dark or early white voyagers.

Whatever the means of entry, recent opinion favours the view that the ancestral marsupials reached Australia millions of years ago as small insectivorous creatures which at that time, perhaps the late Cretaceous or early Eocene, were probably the highest types of mammals and practically cosmopolitan. As they evolved and overran the country the forces of nature adapted them to various circumstances, so that members of the single marsupial order have paralleled the habits and often the general structure of representatives of distinct orders of foreign mammals. For example, the grazing habits of kangaroos parallel those of the hoofed animals, while the flesh-eating habits of native cats and the Tasmanian Wolf have resulted in a remarkable external and dental resemblance to the non-marsupial weasels, cats, and dogs.

Earliest Records—Western Australia.

Though there are many records of Dutch visits to the northern and western coasts of Australia before 1629, the wreck of the *Batavia*, under Captain Pelsart on the Aboothos Islands in that year, is of the greatest interest to naturalists, as it led to the first observation of a member of the kangaroo family, namely, the Dama Wallaby, *Macropus eugenii*, of Peron and Lesueur, which is plentiful on the two largest islands.

As Alexander pointed out, because of the popular supposition that the first discovery of a kangaroo was made by Sir Joseph Banks on Captain

Cook's first voyage in 1770, the following excellent account, written by Pelsart nearly 150 years earlier, is of exceptional interest.

"We found in these islands large numbers of a species of cats, which are very strange creatures; they are about the size of a hare, their head resembling the head of a civet-cat; the forepaws are very short, about the length of a finger, on which the animal has five small nails or fingers, resembling those of a monkey's forepaw. Its two hind legs, on the contrary, are upwards of half an ell in length, and it walks on these only, on the flat of the heavy part of the leg, so that it does not run fast. Its tail is very long, like that of a long-tailed monkey; if it eats, it sits on its hind legs, and clutches its food with its forepaws, just like a squirrel or monkey.

"Their manner of generation or procreation is exceedingly strange and highly worth observing. Below the belly the female carries a pouch, into which you may put your hand; inside this pouch are her nipples, and we have found that the young ones grow up in this pouch with the nipples in their mouths. We have seen some young ones lying there, which were only the size of a bean, though at the same time perfectly proportioned, so that it seems certain that they grow there out of the nipples of the mammae, from which they draw their food, until they are grown up and are able to walk. Still, they keep creeping into the pouch, even when they have become very large, and the dam runs off with them when they are hunted."

Although it was so much later that Cook's famous voyage made the more fertile eastern shores known to the world, and the introduction of the name kangaroo gave promise of the new types of mammals existing in Australia, Banks's description was not so complete as Pelsart's earlier one. The shipwreck of this Dutch navigator and keen observer was associated with a tragic incident, after his departure for Batavia in search of assistance, when the villainous Cornelis and some associates murdered over 100 fellow castaways with the intention of seizing the relief ship and becoming pirates. On the return of the rescue party the design was frustrated and the wretches captured and executed, excepting two, who were abandoned on the mainland and thus became the first white inhabitants of Western Australia.

The next record of a marsupial is found in a brief account by the Dutchman, Samuel Volckersen, published in 1658, referring to Rottnest (rat-nest) Island: "two seals and a wild cat, resembling a civet-cat, but with browner hair," which alludes to the short-tailed wallaby, *Macropus brachyurus*, Quoy and Gaimard, the only mammal on the island. In 1688 the first visit of the Englishman, William Dampier, in the buccaneering ship "Cygnnet," who "fell in with the land of New Holland" in what is now the Kimberley District of Western Australia, led to the first published account of the aborigines. His general account also referred to the animals seen, and stated that "Our strikers brought home Turtle and Manatee [Dugong] every day, which was our constant food." The Dutch accounts of Western Australian natural history conclude with those of de Vlamingh, made in 1696; meanwhile Dampier had become famous by the publication of his travels, and urged the English authorities to equip an expedition for the exploration of Australia in the hope of discovering gold. He was placed in command of H.M.S. *Roebuck*, an ancient almost rotten ship, and after calling at many places en route entered Shark's Bay on the 6th August, 1699.

According to his journal, "The Land-Animals that we saw here were only a Sort of Raccoons, different from those of the West Indies, chiefly as to their Legs; for these have very short Fore-Legs; but go jumping upon them as the others do (and, like them, are very good Meat)." This des-

cription, often claimed as the first account of a kangaroo, actually refers to the Banded Hare-Wallaby (*Lagostrophus fasciatus*), as the French naturalist Peron pointed out when naming it, and giving a delightful description of its habits. The bands on the fur naturally recalled the Raccoon to Dampier, who knew of it from his residence in the Spanish Main.

Dampier's observations led him very much astray on one occasion, in which he describes the stomach contents of one of the sharks, of which he says, "we caught a great many, which our Men eat very savourily. Among them we caught one which was 11 Foot long. . . . In which we found the Head and Boans of a Hippopotamus; the hairy Lips of which were still sound and not putrified, and the Jaw was also firm, out of which we plucked a great many Teeth, 2 of them 8 Inches long, and as big as a Man's Thumb . . . the rest not above half so long"; the flesh of the shark was divided among the men who "took care that no waste should be made of it." The head found in the shark's maw was doubtless that of a Dugong or sea-cow, as Peron later pointed out, and it seems strange that he failed to recognise the head of the marine mammal which as "Manatee" was previously said to have been a constant food. Referring to the habits of the dugong, the French naturalist generously added: "It is to this herbivorous character, which only the dugong shares in this region with the hippopotamus, that the mistake of Dampier must doubtless be attributed; the mistake was the more excusable since the celebrated traveller saw only a head half decomposed by digestion."

It is not possible to traverse the various notes upon mammals which are listed in Alexander's valuable papers on "The History of Zoology in Western Australia," which concludes with the accounts of the French expeditions and the several voyages of Captain Philip P. King, R.N., who in 1817 was directed to complete the survey of the Australian coast begun by Flinders.

Earliest Records—Eastern Australia.

Regarding the discoveries made by Cook and the popular belief that kangaroos were then observed for the first time, it is interesting to note that, contrary to general belief, Captain Cook did not observe a kangaroo at Botany Bay. The indications only of such animal occurs when Cook wrote of the doings at Botany Bay on May 1st, 1770, that "In the woods between the Trees Dr. Solander had a bare sight of a Small Animal something like a Rabbit, and we found the Dung of an Animal which must feed upon Grass and which, we judge, could not be less than a Deer; we also saw the Track of a Dog, or some such like Animal." This completes the account of the Botany Bay kangaroo, and we must travel north to Cooktown, where the *Endeavour* was beached to reach the spot where all Captain Cook's kangaroos were killed. Extracts from Cook's narrative continue, June 24th: "I saw myself this morning a little way from the Ship, one of the Animals before spoke of: it was of a light mouse Colour and the full size of a Grey Hound, and shaped in every respect like one, with a long tail which it carried like a Grey Hound; in short, I should have taken it for a wild dog, but for its walking or running, in which it jumped like a Hare or Deer. . . ." July 14: "Mr. Gore, being in the Country, shott one of the Animals before spoke of; it was a small one of the sort, weighing only 28 pound clear of the entrails: its body was long: the head, neck and Shoulders very Small in proportion to the other parts. It was hair lipt, and the Head and Ears were most like a Hare's of any Animal I know: the Tail was nearly as long as the body, thick next to the Rump, and

Tapering towards the End: the fore Legs were 8 Inches long, and the Hind 22. Its progression is by Hopping or Jumping 7 or 8 feet at each hop upon its hind Legs only, for in this it makes no use of the Fore, which seems to be only design'd for Scratching in the ground, etc. The Skin is covered with a Short hairy furr of a dark Mouse or Grey Colour. It bears no sort of resemblance to any European animal I ever saw: it is said to bear much resemblance to the Jerboa, excepting in size, the Jerboa being no larger than a common rat." . . . July 27: "Mr. Gore shott one of the Animals before spoke of, which weighed 80 lbs. . . . this was as large as the most we have seen."

After leaving Cooktown, in epitomising the natural history, Cook wrote: "Besides the Animals, which I have before mentioned, called by the natives Kangooroo, or Kanguru, here are Wolves [probably dingoes], Possums, an Animal like a ratt, and snakes, both of the Venemous and other sorts. Tame Animals here are none except Dogs, and of these we never saw but one, who frequently came about our Tents to pick up bones, etc. The Kanguru are in the greatest number, for we seldom went into the Country without seeing some."

At once so strange an animal received scientific names, Zimmermann and Erxleben both in 1777 calling it *Jerboa gigantea* and *Jaculus giganteus* respectively, simply basing the names on the description and figure given in Cook's Voyages of the small animal killed at Cooktown. It was natural that the first settlers at Port Jackson should regard their animal as the same as Cook's famous northern beast, but even in Phillip's Voyage (p. 104) we read: "The largest kangaroo which has yet been shot weighed about one hundred and forty pounds. But it has been discovered that there are two kinds, one of which seldom exceeds sixty pounds in weight; these live chiefly on the high ground; their hair is of a reddish cast, and the head is shorter than in the larger sort."

In the "Australian Zoologist" in 1925, Iredale and Troughton traversed the various accounts, and Solander's original description of the Cooktown animal and concluded that the available evidence establishes beyond reasonable doubt that it was not the Great Grey Kangaroo (*Macropus giganteus*) of southern Queensland, New South Wales, and other States, but more probably a species of Wallaroo. As then indicated, additional material has been sought with a view to settling the identity of Cook's animal, and it is hoped to submit a paper involving more definite conclusions in the near future.

The most amusing, if least informative, account of an animal in Cook's Journal is that "one of the seamen, who had been rambling in the woods, told us at his return, that he verily believed he had seen the devil": asked in what form, "He was, says John, as large as a one gallon keg, and very like it; he had horns and wings, yet he crept so slowly through the grass, that if I had not been *afear'd* I might have touched him. This formidable apparition we afterwards discovered to have been a batt [fruit-bat *Pteropus*], and the batts here must be acknowledged to have a frightful appearance, for they are nearly black, and full as large as a partridge; they have indeed no horns, but the fancy of a man who thought he saw the devil might easily supply that defect." The inclusion of this account seems to indicate a very human side of the great navigator's character, and one can almost picture the amusement which it caused him and his officers. To a museum worker the seaman's description of the fruit-bat is strangely reminiscent of the composite ones often employed by inquirers in describing animals which they may have even examined by hand, in which a favourite

term such as "face like a pig" may be applied to a surprising variety of creatures.

It is evident throughout the accounts of early voyagers and naturalists, from the use of names such as civet-cat, racoon, and jerboa, that they were misled by the superficial resemblance of our mammals to those already known; thus we have the kangaroo classed as a jerboa, a rodent no larger than a rat, as Banks remarked, because of similarity of form moulded by adoption of a hopping mode of progression. Again, the ring-tailed phalangers seen by Cook's party were given the name opossum, a word borrowed from the North American Indians and applied to an entirely different family of marsupials. There is a tendency nowadays to shorten the word to "possum" to distinguish the Australian kinds, and it is interesting to note that Cook anticipated the Australian love for brevity by coining the word "Possum," as shown in the above quotation from his Journal. Another foreign name applied to a distinct family of marsupials is "Bandicoot," which is a corruption of a Telugu word meaning pig-rat, originally used for a large species of rat common in southern India and Ceylon. There is no evidence of its first application to the Australian animals, but Collins in 1802, apparently following Bass in 1799, uses it without explanation as a well known name.

Early Exploration—New South Wales.

Though there is not space enough to detail the observations of the early inland explorers, important mammal discoveries recorded by the then Surveyor-General, Major Mitchell, in the journal of his "Expedition to the Rivers Darling and Murray in the year 1836" are of special interest. While near the junction of the Murray and Murrumbidgee, Mitchell first observed the now rare marsupial which became known to the personnel as the "pig-footed bandicoot" owing to but two digits of the fore foot being fully developed. The original specimen had lost its tail, as bandicoots often do, which resulted in Ogilby applying the specific name of "*ecaudatus*" to Mitchell's description and figure, subsequently discarded as inappropriate for an animal normally with a well-developed tail. This type specimen was lodged in the Australian Museum, but some time afterwards unfortunately disappeared.

There still exist in the Museum, however, the original specimens of the first known species of kangaroo-mouse, taken in the same area, which Mitchell said "appears to be the Jerboa, thus, for the first time, seen by us in Australia." He also described the first stick-nests of the so-called Native Rabbit or Rabbit-Rat (*Leporillus conditor*), an indigenous rat then plentiful about the plains of the Murray and Darling, though Sturt secured the first specimen which was named by Gould. After recording that his party frequently observed piles of dry sticks and brushwood which they supposed to be for aboriginal signal fires, Mitchell continues: "Minute examination, however, soon convinced us of our error . . . the materials were not thrown promiscuously together, as would naturally have been the case had they been collected by the natives" for signal fires. . . . "Our kangaroo-dogs also drew our attention . . . barking and scratching whenever we fell in with them . . . intimating that they expected to find something inside. At length, we broke several of them open, a work of no small difficulty from the solidity of the structure, and were not a little surprised to find in the interior a small nest occupied by an animal something between a rabbit and a rat, which had constructed this formidable and massive stronghold to protect itself against the attacks of the native dog. For this purpose the little animal chooses some small bush or shrub, as a

fixed *point d'appui*, to commence its operations; and by gradually working round this, and interlacing the materials of its fortalice, first of all with the growing branches of the centre bush, and afterwards with one another, gradually extends it to enormous dimensions . . . and enjoys the reward of its perseverance and ingenuity in subsequent security and repose. This little animal has ears exactly resembling those of a small rabbit, soft, downy, wool, and short hind legs, and, but for the tail, might readily pass for a small rabbit." The sagacity of these rodents, which were long ago forced from the plains where Mitchell observed them, is shown on the barren Nullarbor Plain in South Australia, where the writer observed some of the nests to consist of low heaps of sticks placed over rabbit warrens; as the bushes are not large enough to support the nests, many of them have small stones rolled or placed on top to counteract the effect of strong winds, much as weights are placed on roofs to keep loose coverings down.

Egg-laying Mammals.

The settlers about Port Jackson soon became interested and sent to England specimens of the curious fauna so that its general characteristics rapidly became known to the scientific world. The discovery of the egg-laying platypus will doubtless ever remain the outstanding discovery amongst the Australian mammals; variously known as Duckbill, Duckmole, and even Watermole, platypus were apparently first discovered in 1797 on the banks of the Hawkesbury, according to the first written account by Collins in his *New South Wales*: "The Kangaroo, the Dog, the Opossum, the Flying Squirrel, the common Rat, and the large Fox-bat (if entitled to a place in this society), made up the whole catalogue of animals that were known at this time, with the exception which must now be made of an amphibious animal, of the mole species, one of which has been lately found on the banks of a lake near the Hawkesbury . . . the most extraordinary circumstance observed in its structure was, its having, instead of the mouth of an animal, the upper and lower mandibles of a duck. By these it was enabled to supply itself with food, like that bird, in muddy places . . . while on shore its long and sharp claws were employed in burrowing; nature thus providing for it in its double or amphibious character."

So contradictory did the furry mammal coat, duck-like bill, and webbed feet then appear to scientists that one named the animal *paradoxus*, while another considered that the first skin might have been a fake constructed by an oriental taxidermist for sale to credulous seamen; such as the "eastern mermaid," consisting of the forepart of a monkey skillfully stitched to the tail of a fish. Fortunately for the zoologists' peace of mind, the even more paradoxical fact that the platypus laid eggs and then suckled its young in the mammalian way was not then known. In 1802, however, dissection of complete specimens by the great anatomist Everard Home removed all doubt of the existence of the quaint creatures, while discovery of mammary glands in 1824 by the German anatomist, Meckel, and subsequent proof that they actually secreted milk, definitely settled the mammalian character of the platypus.

The intriguing question as to whether eggs were laid was then debated, Professor Richard Owen believing the young to be hatched within the parent, whereas the Frenchman Geoffroy rightly contended that eggs were actually laid. In spite of a published report that two white compressible eggs were found in a box imprisoning a platypus over-night, the matter was keenly debated for over eighty years, the question not being finally settled until 1884, when a Cambridge zoologist, W. H. Caldwell, obtained

eggs of both platypus and spiny anteater or "porcupine" in the Burnett River district of Queensland, the discovery being dramatically announced by cable to the British Association for the Advancement of Science then sitting at Montreal.

Although repetition renders commonplace any reference to Australia being a land of living fossils, the fact remains that the egg-laying mammals are literally living fossils walking in a kind of geological sleep, having like zoological Rip Van Winkles retained their unusual form and habits as if they had slept for millions of years and awakened to continue their primitive existence. That they have altered but little for ages is indicated by the fact that no fossil remains have yet been found to illustrate a gradual development, while the skeleton retains definitely reptilian elements which evolution has eliminated from all other furred animals. Excepting the remains of two extinct species of ant-eater, and some of the platypus, from the Post Tertiary (Pleistocene) deposits of Australia, the monotremes are not certainly known as fossils in any part of the world. The discovery in 1888 of true teeth in young platypus was expected to reveal ancestral links, but, although the two largest teeth in each jaw are said to be analogous to molars in form, position, and function, the gaps between the dentition and that of any known mammalian type appear to be so great that there can be no presumption of real relationship until the discovery of closer points of comparison, or intermediate forms.

Marsupials—their Infinite Variety.

Although several kinds of marsupials occur in America, and fossil remains are known from the Paris Basin in Europe, the maximum variety has been evolved in Australia. To the student of mammalian evolution their development in continental isolation is most fascinating in providing perfect illustrations of two great developmental forces, that of *adaptive radiation* in which the original stock spreads out and becomes modified for various environments, and that of *convergence* in which adoption of similar environment and habits by animals worlds apart genetically, as well as geographically, moulds them to an extraordinarily deceptive superficial resemblance.

In this haven of refuge the natural process of adaptive radiation organised a regular army corps of marsupials, with the marsupial mole and wombats representing the tunnellers, the flying possums the aerial forces, and a vast array of kangaroos, wallabies, and smaller creatures as a land army. The discovery in 1888 of the marsupial mole, representative of a distinct family, provides the most recent notable event in mammalian research, mainly because of the extraordinary example of convergent evolution. Though the method and choice of terrain is different to that of the European Mole and Cape Golden Mole, the burrowing existence has resulted in so striking a resemblance between the marsupial mole and that of an entirely different order as to first mislead scientific opinion into the belief that they were genetically related. Once supposed to be restricted to the central region between Charlotte Waters and Alice Springs, its distribution has been extended south to the East-West Railway, and to Wollal on the Ninety Mile Beach, north Western Australia, where a specimen was found in 1910.

The development of skin-folds between the limbs for the spurious or parachute-like flight of our flying possums, or so-called "Squirrels," affords striking evidence of convergent evolution in that a South American Squirrel, and the Cobego or Kaguan of the Malay Archipelago, have independently

evolved a similar appearance, in the orders rodentia and insectivora respectively. The marsupial gliders comprise several genera, the smallest of which is represented by the tiny insectivorous Pigmy Flying Possum with head and body smaller than a mouse and tail haired like a feather, and the largest is the Greater Flying Possum with a head and body about seventeen and a brushy tail about twenty inches long, the favoured diet of which is gum leaves interspersed with wild and occasionally cultivated fruits. Most of us are familiar with the common grey and the ring-tailed possums, but in Victoria occurs a rare genus represented by Leadbeater's Possum which, though first collected and described in 1867 is now known by only five specimens in the National Museum; this genus is considered very closely allied to the "flying" forms, and, though without the gliding membranes at the sides, may have been the primitive form from which the more specialised gliders developed.

A very striking though less rare member of the family Phalangeridae, to which all Australian possums belong, is the Striped Possum found in the Queensland coastal forests and tablelands from Townsville to Cape York, the genus also being well represented in New Guinea. The body coloration consists of sharply defined black and white longitudinal stripes, and, as though conscious of being the most spectacularly coloured of their family, if not all marsupials, the Striped Possums are of shy nocturnal habits. In Queensland, according to the Swedish collector Mjöberg, they hunt eagerly for the nests of small stingless bees for the sake of both insects and honey. The main diet, however, consists of the larvae of beetles and flies which are scratched out from crevices in wood by the disproportionately elongated fourth finger, while the powerful front incisors are adapted for gnawing out the grubs. It is a remarkable fact that these adaptations find a parallel in the lowest member of the Primate order, the Aye-Aye (*Daubentonia*) of Madagascar, in which the powerful rodent-like incisors are used in gnawing away the bark, and the small hooked claw of the greatly elongated finger scratches out larvae from the crevices.

Perhaps the most striking degree of specialisation in the possum family is found in the quaint little Honey Mouse of south Western Australia in which the mouth parts are elongated in a trunk-like way to aid the long brushy tongue to secure nectar and insects from the flowers in the manner of honey-eating birds; in climbing, the opposability of the great toe to the others and the prehensile tail bring blossoms within easy reach, and the dentition shows remarkable degeneration from the original ancestral type in its adaptation to a pulpy and honey diet.

In research upon mammals the dentition is of paramount interest, not only in identifying individual species, but in linking the extant with the extinct, and tracing origin and the course of adaptations to present circumstances. Amongst the marsupials, due to convergent development, we have the beaver-like outward appearance of the wombat associated with a gnawing rodent-like dentition, while the dog-like marsupial wolf of Tasmania has the teeth of a typical flesh-eater, paralleling those of dogs to a remarkable degree, with long canines for grasping the prey, cutting teeth to tear flesh from the bones, and powerful rear molars for crushing bones. Belonging to the same family of marsupials (*Dasyuridae*) is the Tasmanian Devil, and the native cats which are represented by several species on the mainland, and in New Guinea, and which parallel the foreign stoats and weasels, both in general appearance and their habit of attacking and sucking the blood of poultry. As with the possum family, the smaller mouse-like relatives of the flesh-eating marsupials, of the genera *Phascogale* and

Sminthopsis, have the dentition more in accordance with the ancestral insectivore prototype, in which the teeth have needle-like cusps for piercing and breaking up tough insect bodies. The kangaroos and wallabies are typical grass-eaters, and the molars have broad crowns and sharp grinding ridges like those of horses and cattle, though some of the smaller rat-kangaroos show changes due to a partially insectivorous diet.

Marsupial Birth and Transference to the Pouch.

The main claim to popular interest regarding marsupials has, and will doubtless ever be associated with the method of birth and transfer of the young to the pouch. The observations of laymen have usually been upon kangaroos, and there are many country men at the present day who would strenuously support that first account by Pelsart in 1629, which regarded it as certain that the young grew out of the nipples of the mammae. This belief is still a regular source of inquiry at the Museum, and argument occasionally wages fiercely in the press. Some years ago, in response to a brief outline of facts in the "Daily Telegraph," one of the born-in-the-pouch diehards informed Mr. A. H. Chisholm that in spite of "Le Troughton and Co., and all your Pitt and George Street naturalists," he would stick to his opinion. This estimate of one, though amusing, is not entirely correct, as in the course of field work I have a vivid recollection of shattering the life-long belief of an old hunter on Kangaroo Island by dissecting out the unborn young of a kangaroo before his reluctant eyes. There is, of course, considerable justification for views held by untrained observers, who are misled by the smallness and undeveloped appearance of the "pouch embryo," the firmness of its hold upon the teat, and the fact that the mouth bleeds upon forcible removal. The explanation of these matters may be of interest, though it is hardly necessary to stress the anatomical impossibility of young marsupials being born upon the teats which are entirely associated with the supply of milk in the normal mammalian way. Actually, voluntary muscular action lapses on attachment to the teat, and the mouth becomes constricted about the swollen nipple, resulting in rupture and bleeding upon forcible removal.

The early birth of marsupials is due to the union between the embryonic and maternal tissues not being so complete as in the truly placental mammals, in which full union of the blood stream exists by means of placentation of which the navel cord is part. Mainly because of this, the period of development within the parent is limited and marsupials are therefore born in a relatively undeveloped condition. The manner of birth was never doubted scientifically, and can be demonstrated by simple dissection, but the method of transfer of the tiny embryo to the pouch has gradually become known by much patient observation of the shy animals. The belief has been strongly held both here and in America that the parent transferred the young either with her lips or forepaws, but, while there are no known authentic records of this, it is definitely known that the newly-born usually reach the pouch quite unaided. The first recorded observation of this was made over a century ago, when Professor Barton, of Philadelphia, published, in 1806, the following remarks on the birth of the American Opossum in a pamphlet, a copy of which is in the University of Tasmania:—

"The young opossum, unformed and perfectly sightless as they are at this period, find their ways to the teats by the power of an invariable, a determinate instinct, which may, surely, be considered as one of the most wonderful that is furnished to us by the science of natural history. It is

not true, as has been often asserted, that the mother, with her paws, puts the young ones into the pouch."

Over a century later, Dr. Hartmann elaborated similar observations upon American opossums, while there are several authentic records in Australia and America of the unaided journey to the pouch in captive kangaroos. The first Australian account known to me is that of the Hon. L. Hope, read in 1882 and printed in vol. iii. of the Transactions of the Philosophical Society of Queensland, which refers to a kangaroo hunter's observation "that the embryo was working its way through the fur straight towards the orifice of the pouch." His own observation of the young, on the fur of a kangaroo which he shot, was that "closer inspection showed it to be working actively with its fore legs—arms, in fact, which were considerably developed, with the claws apparent." In baby kangaroos the fore limbs are much larger than the hind ones, which is so completely reversed in the adult as to imply that it is a provision of nature to aid in the upward journey to the pouch, which is accompanied by a sort of swimming motion of the arms, and grasping action of the tiny clawed digits. The most recent local observation was made at Taronga Zoological Park in 1926 by three members of the staff, who observed the "foetus" moving slowly up through the fur "with an automatic kind of movement of the fore limbs."

The Balance of Nature.

There is a natural factor known as the balance of nature by which plants and animals retain an approximate equilibrium in their normal habitat. Therefore, if animals are prolific breeders, their population reaches a degree capable of being sustained under normal circumstances. If slow breeders, many species may be on the verge of extinction, like some of our marsupials—others may slowly fade, hold their own, or increase, according to losses sustained before the young are capable of reproducing their kind. The balance is therefore delicately adjusted and may swing in various directions as the result of fire or flood, starvation or plenty, or the introduction of disease or more powerful or prolific enemies. The phenomenal increase and spread of the introduced rats, rabbits, and predatory foxes and cats in Australia is a striking example of species thriving in new surroundings when shorn of the controlling factors of their original habitat. Unfortunately, the majority of marsupials are comparatively slow breeders, few of the larger forms producing more than two young at a time, and so in the disappearance from natural haunts, which threatens extinction for many marsupials, the swing of the pendulum is in the direction of decrease, due to man's disturbing activities.

I have compared the marsupial array to an Army Corps, and it was mainly a peaceful army, a fauna unique in this respect and in its isolation. There were so few predators—the big fellows mostly amiable grass or leaf-eaters—the smaller ones mostly insectivorous. Nature balanced the scales by kindlier means than usual, so that the young were less in those leading sheltered arboreal lives, and more prolific in the small forms leading a more precarious ground existence. Mere size alone, however, carries no guarantee of survival, and ages before white man's arrival the giant marsupials, *Diprotodon* and *Nototherium*, which were about the size of the rhinoceros, had outgrown their environment and faded to the long sleep of their fossil beds.

Advent of Man.

The aborigines probably wrought but little change owing to their inability to cultivate and thus form settled populations, but their bad example

in introducing the first non-marsupial carnivore, the dingo, was all too readily followed by the superior white brother. Prior to the dingo, which Wood Jones has shown to be akin to domestic dogs in northern wolf association, the largest predator was apparently the marsupial wolf or *Thylacine*. This swift and powerful animal, sometimes known as the marsupial tiger because of the camouflaging transverse stripes on its back, not only parallels the dog in appearance, but has adopted the predatory habits of its canine and feline namesakes, even in its attacks upon sheep and poultry.

The pouched-wolf and its smaller carnivorous cousin, the Tasmanian Devil, are now confined to Tasmania, being represented only by fossil remains on the mainland where they were possibly exterminated by the fierce competition of the dingo, which found entry to Tasmania barred by Bass Strait. In this respect the dingo has done an economic, if not aesthetic, service to man, but the underlying tragic significance is this. If the dingo could oust a mammal of similar habits, size, and speed, the inference is that prolonged isolation had left the carnivorous marsupial no match for the more worldly canine. If this be so, then what possible hope of ultimate survival is left the smaller, more timid terrestrial forms, when even the burrowers find their refuges invaded by the wily fox. Their very method of progression limits endurance when pursued, while even the dainty tree-dwellers have no security from their introduced arch-enemy, the domestic cat gone wild.

Effect of Introductions—Useful and Otherwise.

The hunt club formed in Victoria about 1868 to introduce fox-hunting would have much to answer for if charged with a faunal reckoning. Spreading slowly at first, foxes were noticed in Queensland about 1906. While collecting towards central South Australia in 1921, I personally observed the fox to be plentiful, while early in 1932 a correspondent reported that foxes were plentiful about Hughenden in northern Queensland, where they were previously unknown. The one redeeming feature of both fox and dingo is in their preying upon rabbits, but it is all too evident that inroads in that direction are no compensation for their faunal and economic sins.

Unfortunately, the early days of settlement knew none of the strict laws which now govern the introduction of insect, bird, and mammal, and, even though the common rabbit was known as a pest in ancient times, they were deliberately introduced by the first settlers. A return of livestock by Governor Phillip in 1788 reported that three rabbits belonged to the Governor—the officers and men owning another two. They were kept in yards with paling fences to keep them in—not wire-netting to keep them out—while a special game-keeper fed them and destroyed their enemies. Floods swept away the fences, and it is an ironical fact that they were reported “doing well” in 1825, as they have certainly been doing themselves well at our expense ever since, and in 1923-24 alone over a million and a half pounds was spent in netting.

Although rabbit-fur is of the best for making felt hats, and doubtless in masquerading as “coney seal” and “kolinski”—an animal as fictitious as it is supposedly rare—rabbit skins may lessen the demand for those of marsupials, the economic return from exploitation can never balance the losses sustained in grazing capacity and fencing costs. The rabbit has undoubtedly played a serious part in upsetting the faunal balance by crowding out indigenous mammals from favourable habitats, but worst of all in being responsible for the poison-cart with the dreadful mortality of native bird and beast which accompanies that fatal trail.

Even the really essential importations, such as pigs, sheep, cattle, and horses, which have supplied food, transport, and clothing throughout the ages, have played a drastic if unavoidable part in civilisation's advance upon the indigenous army, forcing many fascinating species to unsuitable environments and ultimate oblivion. Apart from the clearing and fencing needed for stock, the white man's domestic animals ever revert to the wild in great spaces, and so wild pigs and other stock in our State, like the buffalo in the north, and wild cats and dogs everywhere, extend their influence far beyond man's scope. When one adds human greed for exploitation to the prejudicial total of man's effect upon nature's balance, it is clear that every effort should be strained, and some sacrifice made, to lessen the fatal consequences in regard to the survival of much of the unique fauna.

Economic Value of Our Mammals.

It is a mistake to consider the value of indigenous mammals merely in terms of fur or food, as many of them, quite apart from the well known usefulness of insectivorous bats, aid man by their destruction of insect pests and mice. In his "Mammals of South Australia," Wood Jones pointed out the usefulness of small pouched-mice, of which there are some fifty odd varieties, and that havoc by insect pests would be lessened if the mice were not preyed upon by domestic cats. He also points out that, although bandicoots are somewhat unpopular because of their habit of scratching in cultivated land, they do an immense amount of good by their untiring energy in seeking and destroying insects. Regarding destruction of mice, Krefft wrote that bandicoots were excellent, and that "we have noticed fifty and more mice killed by one of them" in a little time, while Wood Jones states that the early colonists' tolerance of the rabbit-bandicoot, since then ruthlessly slaughtered, was due to recognition of its extremely useful part in the destruction of mice and insects. Even the poultry raids of the blood-thirsty marsupial Native and Tiger Cats are probably more than atoned for by their destruction of mice, rabbits, and insects. Thus many of the native mammals in their unequal struggle for existence are playing a useful part against man's enemies in maintaining the balance of nature.

Extinct and Fading Races.

There appears no doubt that several species of marsupials have actually become extinct within the brief period of white occupation, and that a considerable number are threatened by extinction in the near future. Even in the hospitable coastal scrubs of south Western Australia the small terrestrial forms are threatened, and two delightful species of rat-kangaroo, which Gould described and figured in his "Mammals of Australia" (*Potorous platyops* and *gilberti*) from near King George's Sound, have not been recorded alive since 1840. Even at that time the former was regarded as rare, while the latter was killed in immense numbers by aboriginal's drives, according to the collector Gilbert. In 1912, Shortridge reported picking up several old skulls of *P. gilberti*, and heard of a small wallaby once plentiful which may have represented it; owing to its sluggish habits and the prevalence of cats and bush-fires it disappeared, and there seems little doubt that both species are almost if not already extinct.

In this same region, the first fat-tailed pouched-mice (*Sm. crassicaudatus*), described by Gould in 1844, were, according to his collector, Gilbert, "brought into the station by a domestic cat, which is constantly in the habit of going into the bush and returning several times during the night with a small mammal or bird in her mouth." From this early ex-

perience, it is not difficult to imagine the appalling wastage of harmless marsupial life which has since resulted over most of the continent from the ravages of tame and wild domestic cats. According to recent information from Mr. L. Glauert, B.A., Curator of the Perth Museum, the dainty Crescent Nail-tailed Wallaby is probably extinct in the settled area, but may still be found in the inhospitable country east of Kalgoorlie, while there is a marked shrinkage in the range of the local Rock-Wallaby. Writing of the sudden and unaccountable reduction of mammals in Western Australia, said to have been first noticed about 1880, Shortridge wrote that the entire disappearance of many species over large tracts of country was generally considered to be due to some epidemic or disease which appeared to be a kind of "marasmus," possibly brought by introduced mammals.

In his "Mammals of South Australia," Professor Wood Jones has given striking evidence of the extinction or drastic shrinkage in the range of many fascinating forms. Of the highly specialised Banded Ant-eater once existing quite near Adelaide, Wood Jones writes: "It is surely a tragedy that this interesting animal has probably passed out of existence in our State, and is rapidly repeating the process in a neighbouring one without any proper study being made of it, and without any representative collection having been made of its remains. It will not be long before *Myrmecobius* will be as extinct as those Mesozoic Marsupials of the English Jurassic beds of which it has been said to be 'actually an unmodified survivor.'"

Even more tragic has been the fate of the Toolach Wallaby (*Macropus greyi*) as its extinction is definitely due to man's greed and folly. Probably the most beautiful and elegant of all wallabies, distinguished by its bold face-markings and waved appearance of the long pale greyish-fawn fur, the Toolach was always confined to south-eastern South Australia. According to Wood Jones, many people remember them as plentiful, and that owing to their fleetness, chasing them was once a favourite form of sport, while the beautiful pelts were marketed in very great numbers in the sales-rooms at Melbourne. It is not correct, he wrote, to say that this fine wallaby is extinct as at the present moment (1924) *five or six individuals still exist*, but "Any effort to preserve this remnant must be made immediately and with vigour if it is to be of any service whatever."

In 1927, Mr. H. H. Finlayson, Honorary Mammalogist to the South Australian Museum, gave a distressing account of the result of efforts to capture living specimens for transfer to the sanctuary on Kangaroo Island. He wrote that by 1923, apart from isolated pairs possibly scattered through rougher country, the sole remnant of the Toolach population living in suitable country was a small band of perhaps fourteen individuals. Two attempts to capture live specimens resulted in over much driving, and four dead or dying animals of this precious remnant. These attentions raised the cupidity of a few unscrupulous people, and survivors have been wantonly killed for the sake of trophies. The sum total of the effort at preservation, according to Finlayson, is that a doe rescued from kangaroo dogs may well represent the last of her race, as in the opinion of a resident the band has been extirpated. He points out also that the species is very poorly represented in Museums, recent inquiry showing that there are but six skins and seven skulls in the public collections of Australia.

Shrinkage of Fauna in New South Wales.

The above instance is quoted at some length to illustrate the urgency of the very real problems to be faced in the conservation of the fauna.

Nearer home, in our own State of New South Wales, there is abundant evidence of the same alarming shrinkage of many beautiful and interesting species. In this regard, it is a striking fact that all the more interesting marsupials and rodents listed in 1865 by that accomplished observer Gerard Krefft, in his paper on "The Vertebrates of the Lower Murray and Darling," appear to have long since vanished from the scene. Of the stick-nest building rats observed as plentiful by Sturt and Mitchell, Krefft wrote: "It is one of the many species which will soon be extinct, as I found that it had already retreated before the herds of sheep and cattle across the Murray."

The quaint and singularly gentle Pig-footed Bandicoot which had been discovered by Mitchell in 1836 was reported by Krefft twenty years later as exceedingly rare and disappearing as fast as the native population. The difficulty in securing specimens was increased by his showing copies of Mitchell's tail-less animal to the natives, which resulted in them bringing large numbers of the common bandicoot with the tail screwed off, to secure the proffered rewards. According to Wood Jones, although its distribution in the Centre is wide, it must be regarded as a disappearing animal, and that the moment open country to which they are now confined is invaded by the fox their doom is sealed.

One of the most striking instances of a fading fauna is provided by the rapid disappearance of the Rabbit-Bandicoot or Bilby from New South Wales. My paper, appearing in this issue, shows that this highly specialised and pest-destroying marsupial, once distributed over the State eastward to the dividing range, has either completely disappeared or been forced to the furthestmost barren western regions. A fine specimen in the Australian Museum was received from Bathurst in 1891, the last of fifteen to reach the Museum since then coming from Moree in 1908. The last account of the living Bilby in our State, to my knowledge, is provided by my colleague, Mr. K. C. McKeown, who had a pair under observation in rocky hills on the Wagga Experimental Farm for about five years prior to 1912, when they were unfortunately slaughtered by shooters from the town.

There is unfortunately abundant evidence of a similar shrinkage in the range of all the species of smaller wallabies and rat-kangaroos. The White-throated Wallaby (*Macropus parma*) once plentiful in the Illawarra district south of Sydney is apparently quite extinct, and represented by only five specimens of which three are in England and two are in the Australian Museum. Gould wrote in 1856 that it "is so very distinct from all the other small *Halmaturi* [wallabies] inhabiting N.S.W., that the aborigines who hunt these animals recognise it immediately by the native term I have selected as a specific appellation; this remark applies more particularly to the natives of Illawarra, in which district I myself saw it in a state of nature. In these extensive brushes it doubtless still exists. . . . How far its range may extend westwardly towards Port Phillip, or eastwardly in the direction of Moreton Bay, I am unable to state." This uncertainty of range, which Gould illustrated with some uncertainty as to orientation, will never be cleared up now, as the last of the two Australian Museum specimens was collected in 1889, and there have been no recent evidences of its possible survival. Other coastal forms which show a continual shrinkage in range are the brush-tailed Rock-wallaby, which is such an attraction about the Jenolan Caves, the pretty Bridled Nail-tailed Wallaby, and the Padymelon, Black-striped, and Red-legged wallabies which are now confined to the North Coast of the State, and all species of the quaint little rat-kangaroos.

It is not possible to elaborate these instances of shrinking fauna, but

when it is realised that evidences of fading, and the effects of settlement were noted by Krefft as early as 1865 on the plains of the Murray and Darling, and this *before the advent of the fox*, it seems evident that any hope of New South Wales providing a sanctuary for many of these harmless and fascinating indigenes has gone forever. The history of our State in this respect is but the history of Australia, and there is urgent need for all Governments and Societies to unite in the national cause of conservation.

Research, Survey, and Conservation.

An unfortunate but very natural result of the early recognition of the paramount interest of our mammals was that the collections of officials, settlers, and visiting naturalists were sent overseas to be described and stored for all time. Until recently, therefore, the bulk of mammalian research has been carried out abroad, and local workers have been handicapped by the fact that many species are known only by meagre descriptions of material not represented in their collections. Additional confusion has resulted in that for a long time no attempt was made adequately to localise individual discoveries, so that a great amount of field work remains to be done in checking, not only the present range of many species, but their identity as well.

There is at present a sort of renaissance in mammalian research which makes it abundantly clear that the work can be carried out in Australia. An essential to progress, however, lies in the active carrying out of field investigations of which the collecting of adequate study material is a vital part. There is a tendency in misinformed circles to regard this field work as being in the nature of a pleasure jaunt or luxurious relaxation for the naturalist, but to those who have experienced the gruelling routine of the dawn patrol of traps, day long tramps, and long nights of skinning, tabulation, and preservation, such criticism becomes intolerable, especially when it limits the very work for which sacrifices are made. Of recent years, this lack of appreciation has led to the unreasonable practice of professional workers frequently having to expend both their own time and resources upon furthering a national duty.

Splendid service has been rendered by private individuals, such as in the fine series of acquisitions to the Australian Museum, made possible by the enthusiasm and personal expenditure of Mr. A. S. Le Souef, C.M.Z.S., while the recent rediscovery of the "extinct" Plain Rat-Kangaroo (*Caloprymnus campestris*), by Mr. H. H. Finlayson, Honorary Mammalogist to the South Australian Museum, is a striking example of the importance of field work. Although this remarkable marsupial was made known to science by John Gould in 1843 upon examination of three specimens sent to the British Museum from South Australia by the Governor, Sir George Grey, no further specimens were obtained for over eighty years, and the species had apparently become extinct without a single trace in an Australian museum.

The first hint of its survival in the Diamantina region of South Australia came to Mr. Finlayson from his friend and collaborator, Mr. L. Reese, and a visit towards the end of 1931 resulted in the securing of an excellent series of specimens, notes and photos, upon which a paper is soon to be published. As the discoverer wrote, "Imagine the feelings of a naturalist in search of a small creature which the world had placed among the extinct species, at seeing before him a dainty creature, a 'pale ghost of the 1840's,' recalled as it were from the long dead past to become the quarry in one of the most eager hunts man ever made." The notable achievement

was accomplished entirely at the expense of Mr. Finlayson during his vacation, and that it was no easy task is shown in the following extract from one of his letters: "I was naturally pleased about *Caloprymnus*, but have endured some torment to get him. . . . Sand hills, gibbers, and clay pans, and a blistering heat, with flies, mosquitoes, and sand-flies thrown in. I have been almost constantly in the saddle, have ridden 350 miles and done 800 by car. I shall never forget the last day's ride across the western end of Sturt's stony desert, with the temperature at 113°."

The above is but one instance of the importance of the vast amount of field work which remains to be done throughout the length and breadth of our continent, and which all must realise is the basic need of any attempt at adequate control and conservation. The importance of making an organised attempt to study the fauna in its natural surroundings was urged by the late Professor Sir Baldwin Spencer in 1921, while in the same year the Zoology Section of the Australasian Association for the Advancement of Science carried a resolution favouring an immediate co-ordinated investigation of the fauna. Also in 1921, in his Presidential Address to this Society, Mr. W. W. Froggatt, F.L.S., urged the necessity for setting up a Bureau of Biological Survey and detailed the American achievements in this regard. In the following year in his Presidential Address to the Linnean Society of New South Wales, Dr. G. A. Waterhouse endorsed the plea for the immediate undertaking of a zoological survey of Australia, pointing out that, while the need for systematic surveys had been recognised in Geology and Botany, zoology had not been provided for.

Over a decade has passed since these urgent and authoritative representations were made, yet nothing of a co-ordinated or systematic nature has been attempted. In the United States the Division of Biological Survey has achieved unity in the research, control, and exploitation of the fauna, and it is sincerely to be hoped that a similar institution may be established in Australia in the very near future.

In spite of the unique interest of our fauna the science of mammalogy has been comparatively neglected in Australia, mainly due to the understaffing of museums, and the tendency to bind research workers too closely to the wheel of fixed routine. Local museums do what they can with inadequate funds, and of recent years the Australian Museum has actively encouraged private enthusiasts by the provision of collecting gear and instructions. With the object of securing material from a wide range of localities at present out of reach of local workers, collecting cans have been sent to various places on the mainland, and to New Guinea and the Pacific islands. In this way excellent series of known forms hitherto unrepresented in Australian collections, and sometimes new species, have been obtained. Occasionally such gatherings are supplemented by brief expeditions to the field by museum men, usually at the partial expense of the worker, and it is a regrettable fact that on these rare occasions the rush to secure material with the meagre funds and time allotted prejudices results and gives little insight into the ways of the wild.

The need for an active survey of our fauna from a national point of view is indicated by the activity of overseas collectors in the past. During my tour of foreign museums in 1930, for the purpose of studying mammals, and the technique of display and storage, I examined Australian and New Guinea species in British, German, and Scandinavian museums, which are not yet represented in any Australian museum, and which may become extinct before we acquire representatives, unless effective field-work is carried out. In America, field-work is not only an integral part of museum prac-

tice, but is now recognised as part of the university graduate course in zoology. There is also an American Society of Mammalogists which publishes a quarterly Journal and meets in annual congress in different cities. In America, too, the great museums are objects of national and civic pride, and regarded as attractions to visitors, a notable example being the American Museum of Natural History, New York, with a staff of 500. The large scientific staff is required to undertake considerable field-work, often totalling as much or more than half the actual working time, and in one year recently over thirty expeditions were undertaken, to places as far afield as China, Africa, and Australasia. These remarkable activities can only be carried out with the aid of endowment by wealthy citizens with a patriotic interest in the fauna, as an entire dependence upon governmental funds automatically limits activities, both as to scope and the claims of official regime. These helpful endowments are largely obtained in America from a list of subscribing patrons, who receive titles such as "Endowment Member" or "Benefactor," according to the assistance provided, and who receive certain publications and privileges by means of which their interest is maintained. It seems quite evident that similar methods will have to be adopted in Australia if museum work upon the fauna is to progress.

The paramount matter of a zoological survey, however, cannot be carried out by independent action in the various States, but should be controlled by a centralised bureau which could organise a systematic survey. In America, as early as 1885, recognition of the importance of birds to agriculture led to Congress appropriating 5,000 dollars to be expended, under the direction of the Federal Division of Entomology, and the following year the work relating to birds was given separate status as the Division of Biological Survey, which now includes the mammals.

We have reached a stage in Australia, nearly fifty years later, when we should follow America's proved example, with the advantage of much experimental legislation to guide us, and with a simplified task in only having six instead of fifty individual States and territories to consider. We already have a Commonwealth Division of Economic Entomology, which shows a striking parallel with the inception of the Biological Survey in America, and one may venture to suggest that in view of the economic importance of birds and mammals, the time is opportune for the Federal authorities to initiate the formation of a Bureau, or to arrange for an advisory conference. Apart from the Division of Economic Entomology, we have our Council for Scientific and Industrial Research, our National Research Council, numerous scientific societies, and State Universities and Museums, and a conference of representatives should have no difficulty in advising upon at least some measure of Biological Survey.

The first duty of the Bureau would be to co-ordinate game and protection acts and thereby control exportation, and prohibit the importation of undesirable fauna. The economic value of the Bureau regarding mammals would include investigation, and attempted control of mouse and rat plagues, depredations of wild dogs and foxes, and the spread of such animals as deer, which are now a pest in New Zealand.

The rabbit industry might also be utilised to better advantage in limiting pastoral damage, as it is uneconomic to declare open seasons for harmless marsupials, such as native bears, and so divert rabbit trappers from a useful occupation, while poison is extremely wasteful of the fauna and

might possibly be eliminated if rabbit destruction was more systematically planned.

To nature-lovers, however, biological survey is important as providing the only hope of survival for much of the unique fauna. There is an amazing variety of faunal regions in Australia, and it would be the work of the Bureau to chart the natural populations, report conditions, advise upon adequate reservations, and attend to their control. There is also a distinct educational value in such a Bureau, the propaganda of which would tend to make people sufficiently mammal-minded to prohibit cruel and uneconomic slaughter of harmless species. Cost of the Bureau would be contributed to by a small levy on exportable skins, and from their sale, when limitation of kangaroos or possums became necessary in any area.

There is a world-wide movement for the conservation of native fauna, and in 1930, while visiting the Harvard Museum of Comparative Zoology, I met the President of the International Office for the Protection of Nature, who had crossed from Brussels for a discussion with the American Committee for International Wild Life Protection. The anxiety of the American Committee to co-operate in conserving the Australian fauna is shown in the suggestion that laws could be considered which would prohibit the importation to the United States of species for which total protection was desired. In view of this international concern, we must not continue our exploitation of the marsupials until some measure of biological survey is instituted. Only by such control, and international co-operation, uniting Governments and nations alike in a veritable league of nature, can many fascinating creatures be saved for posterity.

Errors of Exploitation and Need for Protection.

In the cause of wild life preservation we must sacrifice something to a national ideal and forego the sordid profits of commercial exploitation. If the dole is a bad thing save as an urgent expedient, surely it is unsound to cultivate in any section of the community a dependence on the slaughter of our unique mammals. It is necessary, of course, for the protection of pastoral interests that undue invasion of kangaroos or emus must at times be checked, but the declaration of open seasons purely for revenue purposes constitutes a kind of "back to nature" movement which is a nationally unworthy one.

In last year's brief open season 750,000 possums were slaughtered by means of gun, poison and snares which all too often result in slow strangulation. When it is considered that an additional danger lies in the encouragement of trappers to take skins illicitly in the hope of later open seasons, or with the intention of disposal in other States, it may be realised with what genuine relief and appreciation the Government's recent decision against an open season was received by the Council of your Society. The common possum is utterly harmless when restricted to the bush, and when troublesome about the homestead or in orchards is readily dealt with by local action. The Koala, however, is utterly harmless everywhere, and what a delight it would be for both young and old if they were plentiful enough to haunt the suburbs and homesteads as possums often do. They seek only the freedom of the trees, and if the continued slaughter of such innocents leads to their extermination, it must inevitably appear to later generations as an indictment of the cultural degradation of our time.

The past wholesale uneconomic exploitation of possums, Koala, and kangaroos and wallabies is so well known as to hardly require the repetition

of oft quoted figures, but the appalling slaughter as far back as 1906 is shown by the fact that in that year 4,161,685 possums, and 60,000 wallaby skins were marketed in London and New York alone. In 1924, the colossal total of over two million skins of the Koala or Native Bear were exported and mainly sold under the name of "wombat" to mask the wholesale slaughter. In the Queensland open season of 1927, approximately 600,000 Koala were massacred by 10,000 licensed trappers, and this in spite of the fact that the fascinating creatures have been almost swept from Victoria, largely due to an epidemic disease, and are rapidly vanishing in New South Wales.

The first essential towards conservation of the fauna lies in a unified governmental agreement against the exploitation of harmless species for revenue. Who can doubt that the platypus with its lovely fur would be in danger of extermination were it not for total protection, and the rest of the fauna is all too heavily handicapped by the inroads of civilisation, with its sins of commission in the introduction of natural enemies and commercial exploitation, and omission in the lack of adequate reserves and protective measures. The introduced mammals are the prosaic essentials, but the monotremes and marsupials are amongst the natural glories of our Australian garden. Age has not withered them, nor could custom have staled their infinite variety, but now we must act quickly and concertedly to preserve the already vanishing stock.

Pleading protection's cause in Museum lectures to school children, I have sometimes reminded them of Barrie's "Peter Pan" and his fantasy of the fairy kept alive by the children's belief in their existence. The children of to-day—all too soon—are the grown-ups of to-morrow, and young and old alike must put the weight of their united opinion behind any movement for the provision of sanctuaries and general protection for the ancient inhabitants of our adopted land. Only by such universal belief in their right to existence can we hope for the survival of many fascinating creatures, for the delight and instruction of the generations to follow, so that, in the words of Kipling's beautiful *L'Envoi*:—

"Each for the joy of the working,
And each in his separate star,
Shall draw the thing as he sees it,
For the God of things as they are."

ROYAL ZOOLOGICAL SOCIETY OF NEW SOUTH WALES.

Election of Officers, 1932-33.

At a meeting of Council, held on 3rd August, 1932, the following officers were elected:—

President: Neville W. Cayley; Vice-Presidents: Professor W. J. Dakin, T. Iredale, T. C. Roughley, and E. L. Troughton; Hon. Secretary and Editor: A. F. Basset Hull; Assistant Hon. Secretary: Clifford Coles; Hon. Treasurer: Phillip Shipway; Hon. Librarian: A. S. Le Souef.

New Members.

The following new members have been elected since the date of the last list (5th February, 1932):—

Ordinary Members.—K. M. Crawford, Miss H. McRobert, L. J. Perry, P. Leahy, P. Radford, Mrs. A. F. Cleburne, F. O. Clarke, A. Durbridge, H. E. Peir, E. Blattman, J. W. Catt, E. Drew, A. C. W. Hill, M. Kent, P. Marks, P. Wood, and L. H. Winkworth.

Associate Members.—Miss M. Feldwick, W. Healy, L. Franzen, N. McGilvray, A. F. Norris, M. S. Sharland, P. N. Whitley, Mrs. Whitley, S. Ayling, J. E. Burns, Miss K. English, T. Flynn, S. French, J. C. Fay, K. Hardwick, Dr. Z. Halloran, E. J. Horn, J. Lumsden, Miss L. Lodge, R. J. Murray, H. Napier, B. O'Brien, E. J. Priestley, Dr. J. I. Parer, S. E. Shutt, R. W. Taylor, T. White, R. F. Woods, and Mrs. K. Ziemann.

SYLLABUS OF SECTIONAL MEETINGS, JULY-DECEMBER, 1932.

Avicultural Section.

(Second Monday in the month.)

- 12th September.—“Moving Pictures,” by Norman Chaffer.
- 10th October.—“Doves and Pigeons,” Tom Iredale.
- 14th November.—“Our Honey-eaters,” P. A. Gilbert.
- 12th December.—“Birds of Paradise,” J. E. Ward.

Marine Zoological Section.

(First Monday in the month, except on public holidays, then on the following Tuesday.)

- 5th September.—“Around Australia's Northern Boundary,” A. A. Livingstone.
- 4th October (Tuesday).—“Not Quite Fishes,” G. P. Whitley.
- 7th November.—“Marine Life of the Local Shore,” W. Boardman.
- 5th December.—“Goldfish in the Home,” T. C. Roughley.

Ornithological Section.

(Third Friday in the month.)

- 19th August.—“Extinct Birds,” Tom Iredale.
- 16th September.—“Birds of Tasmania and South-eastern Australia,” Michael Sharland.
- 21st October.—“Sidelights on Nature,” P. A. Gilbert.
- 18th November.—“Victorian Days,” A. H. Chisholm.
- 16th December.—General discussion.

Meetings are held at the office, Bull's Chambers, 28 Martin Place, at 7.30 p.m. Members may bring friends.

NOTES ON AUSTRALIAN PAPILIONIDAE.

(Part I.)

Papilio aegaeus, Donovan. Descriptions of a new female form and two aberrations.

By G. A. WATERHOUSE, D.Sc., B.E., F.E.S., F.R.Z.S.

Plate xi.

In this series of notes, I hope from time to time to give some interesting facts about these large and handsome butterflies. The popular name of "Swallowtails" was applied to them over a century ago, owing to the only species found in Europe having tail-like projections to the hindwings. Many of them, however, are without tails. They are more plentiful in the tropics, but extend to the temperate regions of Australia, one even being found in Tasmania. Like most Australian butterflies, they are more common within 50 miles of the sea coast, only one occurring commonly inland.

Papilio aegaeus is one of the most interesting butterflies of the Australian region. It is found in varying geographical races throughout New Guinea and the adjacent islands, such as the Bismarks, Aru, Key, Banda, Mysol, Salawatti and Waigeu, and also in Eastern Australia. In the Southern Moluccas it is represented by a very closely allied species, *Papilio gambrius*.

The sexes are dissimilar, and in many parts of the range of the species two or more female forms are found. Six different female forms from New Guinea have received names. The usual female is the one that is so well known in Eastern Australia, and a form similar to this is found wherever the species occurs, accompanied in some localities by one or more other females, which vary in the direction of being almost white above, or in the other direction of having the forewing above entirely dark brown.

The New Guinea race is known as *P. aegaeus ormenus*. All the specimens I have seen from Darnley and Murray Islands show the characters of *ormenus*, rather than of typical *aegaeus* from Sydney. From Banks Island and the islands adjacent to Cape York, though the specimens are not quite typical *aegaeus*, they belong to that race rather than to *ormenus*. Amongst other characters, the female of typical *aegaeus* can be recognised by the extension of the central white area of the hindwing below towards the costa as a white bar between veins 7 and 8. This white bar varies in width, usually being much wider in the south than in the north.

In the Victorian Naturalist, Vol. xxv., p. 118, 1908, I described the white female form of *Papilio aegaeus* from Cape York and Prince of Wales Island. Only twelve specimens of this form, which I called *beatriz*, are known. Additional localities are Thursday Island and Ingham, Herbert River (one specimen). I now give the description of a much rarer female from within the limits of Australia, which corresponds to the form *timoxena* of *P. aegaeus ormenus*.

PAPILIO AEGEUS, female form TULLIA, nov.

Female: Length of costa of forewing about 70 mm.

Upperside: Forewing brown-black, with a band of 5 irregular creamy-white spots between veins 4 and 10, bordering the outer end of cell. Hindwing dark brown-black, with a large central creamy-white area between veins 1a and 7; this crosses the outer end of cell and extends half-way towards termen; it is followed by a series of blue scalings, more developed in spaces 2 and 3, and a subterminal row of 7 prominent red lunules. Cilia of both wings cream, broadly interrupted at terminations of veins.

Underside: Forewing dull black; spots white; a broad spot near end of cell and a series of spots between veins 1a and 10, those between 4 and 10 much longer than above. Hindwing black; central white area more restricted basally than above, not crossing end of cell and extended as a thin white line between veins 7 and 8; blue scalings more developed than above, subterminal lunules orange red.

One female from Moa (Banks Island) in Australian Museum, Sydney, from J. W. Schomberg.

This specimen differs from the five ordinary females from Banks Island in the Australian Museum in the absence of the large pale spot near end of cell in forewing above; by the presence of the five distinct spots of forewing above; by the less pure white colour of the central area of hindwing above; by the smaller white spots of forewing below; by the central white area of hindwing below not entering end of cell.

From Darnley and Murray Islands I have two females of the corresponding form (*timoxena*) of *P. aegaeus ormenus*. Both are without the spot in cell of forewing below and the white bar between veins 7 and 8 on hindwing below. On the hindwing both have less blue scalings above and below and the subterminal spots are much paler.

This brings the number of female forms of typical *Papilio aegaeus* to three. The ordinary female which occurs over the whole range and the only one found from Townsville south; the *beatriz* from Cape York, Prince of Wales and Thursday Islands, and one from near Ingham; and *tullia*, one specimen from Banks Island.

Mosaic hermaphrodites.

Two very interesting mosaic hermaphrodites are known. In examining these specimens it should be noted that both the dark and light scales of the sexes can be easily recognised. The dark scales of the male are black and easily distinguished from the brown-black scales of the female. In the female the pale scales are pure white, but in the male dull white.

The first specimen (plate xi., fig. 1, upperside; fig. 2, underside) belongs to the typical race *P. aegaeus*.

Left side, above and below, wholly male. Right side, hindwing above and below, wholly female.

Right side: Forewing; upperside chiefly female; black male scales as follows: Two longitudinal streaks in lower half of cell, below cell and vein 4 numerous streaks and patches, above vein 4, female except in space 5, which has several patches of black and of white male scales. Underside

chiefly female; black male scales as follows: One longitudinal streak near lower edge of cell, patches between dorsum and vein 4, but not so extensive as above. Above vein 5 to costa female. Space 5 has male scales above but none below. Space 4 has no male scales above, but patch below close to the cell.

This specimen is in the National Museum, Melbourne, and is from Queensland, Mr. Pilchard's collection, December, 1882.

The second specimen (plate xi., fig. 3, upperside; fig. 4, underside) belongs to *P. aegeus ormenus*, and is a much more complex specimen than the first.

Right side: Forewing above, male except some dull brown-black female scales between end of cell and termen and a small patch near anal angle. Below male with female scales in cell and irregularly between cell and termen and dorsum.

Right side: Hindwing above, upper half female above a line from base along middle of cell and vein 5, below this line male with a few female scales scattered over the wing and two red female subterminal spots. Below all female.

Left side: Forewing above chiefly male, most of cell female excepting a central longitudinal male streak; mostly female from end of cell to apex. Below almost as above.

Left side: Hindwing as right side, but no female scales in lower male half. Below upper half female, lower half male with a few female scales.

This specimen is in the Australian Museum, Sydney, from Darnley Island, 23rd June, 1910, caught by H. Elgner.

In this specimen the differences in colour between the scales of the sexes is well shown in the large central white patch of the hindwings above.

EXPLANATION OF PLATE XI.

Fig. 1, upperside; fig. 2, underside of mosaic hermaphrodite of *P. aegeus* from Queensland.

Fig. 3, upperside; fig. 4, underside of mosaic hermaphrodite of *P. aegeus ormenus* from Darnley Island.

All figures about two-thirds natural size.

NEW GENERA OF AUSTRALIAN HESPERIIDAE AND A NEW SUBSPECIES.

By G. A. WATERHOUSE, D.Sc., B.E., F.E.S., FR.Z.S.

During the visit of Brigadier W. H. Evans to Australia early in 1932, the opportunity was taken to thoroughly discuss this family of Australian butterflies. General Evans brought with him a very large number of species from the Australian and Oriental regions, which, together with those in the Australian Museum, made a greater number of species than had ever been gathered together before from the Australian region. It was mutually agreed that I should describe new genera, species and subspecies belonging to Australia, whilst General Evans would describe those from the Papuan and Polynesian subregions and the Oriental region.

A paper describing a number of new subspecies has already been read before the Linnean Society of New South Wales, and will be published in September. This communication is the result of study begun in Sydney, but not concluded before General Evans left Australia. General Evans finished the work on the voyage to England, and at the British Museum. He has sent his notes to me with the suggestion that I should publish the Australian portion. Without his great assistance the work would not have been so complete, as many of the genera range beyond Australia, and a study of Papuan and Oriental forms is necessary to understand the Australian species.

In this family, there are no great differences in wing venation, but variations in the shape of the antennal club have been found to furnish reliable clues to the separation of genera. The presence or absence of secondary sexual characters, though useful, are not of primary importance. The male genitalia show a certain amount of variation; generally speaking, differences in the clasp are not of generic value, but marked differences in the uncus may be of importance.

Subfamily TRAPEZITINAE.

Of the fifty-four known species, fifty-one are confined to Australia, where their development has presumably proceeded without external interference. The remaining three species occur in the Papuan subregion. The only allies appear to be a few species from Madagascar, which however may not even belong to this subfamily.

ANISYNTOIDES, n.gen.

Antennae shorter than half the length of costa of forewing; antennal club bent beyond the middle, with apiculus short and blunt. Forewing with vein 5 almost straight; origin of vein 2 nearer base than end of cell; origin of vein 3 near end of cell. Male without a sex brand. Genotype *argenteo-ornatus*, Hewitson, from Western Australia.

This genus contains the one species which is a much stouter built insect than *cynone*, the genotype of *Anisynta*, and the species congeneric with it. In its antennal characters it differs from *Trapezites* and *Anisynta*.

PASMA, n.gen.

Antennal club bent before the middle, apiculus blunt. Forewing with origin of vein 2 midway between base and end of cell. Male without sex brand. Genotype *tasmanica*, Miskin.

This genus will also contain the rare species *polysema*, Lower. The two species have pointed forewings and are stoutly built.

ANISYNTA, Lower.

In "The Butterflies of Australia," 1914, p. 181, it was pointed out that the genus as treated there contained somewhat divergent species. I have separated the three stoutly built species above and propose to extend the genus to include *monticolae*, Olliff, and *dominula*, Plötz, both of which have a sex brand on the forewing in the male. The antennal club is short, arcuate about the middle, apiculus blunt. Forewing with origin of vein 2 midway between base and end of cell. Palpi half as long again as head, instead of as long as head in the other genera. Male without or with a sex brand. Genotype *cynone*, Hewitson.

ANISYNTA CYNONE, Hewitson.

Cyclopidides cynone, Hew., *Exot. Butt.*, v., fig. 14, 1874.

General Evans has examined the type in the British Museum, which is a male labelled "Australia." He considers that neither the South Australian nor the Victorian specimens he took to London are identical with the type, but should both be regarded as races of *cynone*. The locality of the type *cynone* must for the present remain in doubt.

CROITANA, n.gen.

Antennae about half the length of costa, antennal club bent well before the middle, apiculus very blunt. Forewing with origin of vein 2 much nearer end of cell than base. Male without sex brand on forewing. Hind tibiae with only one pair of spurs. Uncus ending in three blunt points. Genotype *croites*, Hewitson, from Western Australia.

The position of this species in the genus *Mesodina* has never been satisfactory. Its facies is very different to the two species of *Mesodina*, and its main point of agreement is the presence of a single pair of spurs on the hind tibiae.

FELICENA, n.gen.

Antennal club bent beyond the thickest part to a finely pointed apiculus. Forewing with vein 5 sharply bent down at origin, vein 2 at origin midway between base and end of cell. Male with a black discal brand on the forewing above composed of very long hairs. Uncus ending in four prongs. Genotype *dirpha*, Boisduval, from New Guinea.

One of the most important factors in this subfamily is the early stages of the insects. I have been able to find larvae and pupae of twenty-three of the species, and have some information concerning several others. These early stages may be divided into three sections. (a) Trapezitine: Fat, humped larvae, usually some shade of brown, feeding on *Xerotes* and grasses. Short, stout, pupae with anterior end rounded, usually brown. (b) Hesperilline: Long, cylindrical, semitransparent larvae, usually greenish, resembling the larvae of the Pamphilinae, feed chiefly on species of *Gahnia*. Pupae long, cylindrical, green or black, anterior end ending in two long blunt projections or two flattened projections, these head pieces become detached on emergence and provide specific characters. (c) Mesodine: Subcylindrical, hairy, larvae covered with long hairs, feed on *Patersonia*. Pupae dull black, with head piece smooth and slightly raised knobs, pupate head downwards.

On account of the early stages it has been found necessary to remove *matindeva*, Lower, from *Toxidia* and place it in *Hesperilla*.

The Australian species of this subfamily will fall into the genera as follows, the first species being the genotype.

TRAPEZITES.—*symmomus*, *iacchus*, *eliena*, *heteromacula*, *lutea*, *petalia*, *sciron*, *iachoides*, *maheta*, *phigalioides*, *phigalia*.

ANISYNTOIDES.—*argenteo-ornatus*.

ANISYNTA.—*cynone*, *sphenosema*, *tillyardi*, *monticola*, *dominula*.

DISPAR.—*compacta*.

PASMA.—*tasmanica*, *polysema*.

SIGNETA.—*flammeata*, *tymbophora*.

TOXIDIA.—*tyrrhus*, *parvula*, *peroni*, *sexguttata*, *crypsigramma*, *doubledayi*, *leucostigma*, *melania*.

NEOHESPERILLA.—*crocea*, *xiphiphora*, *senta*, *xanthomera*.

OREISPLANUS.—*munionga*, *perornata*.

HESPERILLA.—*ornata*, *picta*, *crypsargyra*, *mastersi*, *idothea*, *donnysa*, *chryso-tricha*, *chaostola*, *andersoni*, *malindeva*.

MOTASINGHA.—*dirphia*, *atralba*.

MESODINA.—*halyzia*, *aeluropis*.

CROITANA.—*croites*.

Of the three species from the Papuan subregion *dirpha*, Bolsduval (= *albicilla*, Joicey and Talbot) is in the new genus *Felicensa* and *inornatus*, Butler (= *maykora* Plötz), and *arfakensis*, Joicey and Talbot fall into *Toxidia*, being closely allied to *melania*.

Subfamily PAMPHILINAE.

The information General Evans has sent me since his return to England necessitates the following changes.

ARRHENES Mabilles.

The genotype is *marnas*, Felder. There are two *marnas*-like species in North Queensland. Under the impression that the larger and commoner species was the Australian race of *marnas* from Amboina, the smaller and rarer form was described as a new species, under the name *affinis*. This is not the case, as the smaller species is the only one found in Amboina, and the type is in the Tring Museum, and *affinis* is the Australian race. The larger species belongs to *colattus*, Plötz, though it was described from Delagoa Bay. General Evans has examined a copy of the unpublished figure of Plötz, and is certain that it represents the larger *marnas*-like species from New Guinea, and that the locality given by Plötz is a mistake. Both *marnas* (with the Australian race *affinis*) and *colattus* fall into Mabilles's genus *Arrhenes*.

PADRAONA TANUS, Plötz.

Apauustus tanus, Plötz, *Berl. Ent. Zeit.*, 29, p. 228. *Padraona sunias*, Auctorum.

The species *sunias* was described from Amboina, and is without the sex brand in the male, which is present in the Australian species, to which the name *sunias* has been wrongly applied. Two races are found in Australia,

and are described by Lower, *Trans. Roy. Soc. S. Aust.*, 1911, p. 150-1, as *Ocybadistes rectivitta* and *O. sunias*, and in "The Butterflies of Australia," 1914, p. 204, figures as *Padraona sunias*.

PADRAONA TANUS NIHANA, Fruhstorfer.

Ocybadistes tanus nihana, *Iris*, 1911, p. 44.

On the upperside of the forewing the orange-yellow band is as wide as the black marginal band, the entire basal area is orange-yellow; on the upperside of the hindwing the discal orange-yellow band is wider than the marginal black band, and there are usually orange-yellow spots in areas 6 and 7. On the underside of the hindwing the markings are complete.

Typically from Waigou; also found at Port Darwin and in North Queensland, the Key and Aru Islands.

PADRAONA TANUS NOLA, n.subsp.

Male: Upperside, forewing brown-black, with cell broadly orange, extending to base, but not continuously to dorsum, and just touching sub-apical dots, discal orange band narrow, internally bordered from veins 1a to above vein 4 by an oblique sex brand; longitudinal orange streaks above and below vein 1a towards base. Hindwing brown-black, with a moderately broad orange discal band, with a minute spot in area 6, sometimes absent, and an orange spot in cell. Underside with the markings as above, but very much obscured in the orange-brown colour of the apex of forewing and the hindwing, an additional faint spot in area 7 of hindwing, which also has a faint greenish tint.

Female: Upperside, brown-black, with markings much narrower and darker than in the male, the base of forewing wholly brown-black. Underside as in the male.

Described from six males and one female from Port Macquarie in November in the Australian Museum. The range of this race will be from the Manning River to Brisbane. It differs from the northern race in that the orange markings are much narrower, and there is also a brown-black streak in the male, under the median vein, reaching the base. On the underside, the markings are not so prominent as in the northern race.

BAORYNNIS, n.gen.

Antennae very short, not as long as vein 12; antennal club stout, rounded with a short pointed apiculus. Forewing with apex of cell produced, vein 5 opposite vein 9. Hyaline spots on both wings. Male without a sex mark. Genotype *amalia*, Semper.

This genus forms the transition from the *Pamphila* group to the *Baoris* group.

FOUR NEW SPECIES OF DRYOPIDAE, TOGETHER WITH NOTES
ON THE FAMILY.

(Order COLEOPTERA.)

By H. J. CARTER, B.A., F.E.S., and E. H. ZECK.

(Plate xii.)

Since the publication of our Monograph (1) a more general interest has arisen in this family, and many friends have sent their captures from all the Eastern States. The examination of these shows a large number of individuals, but little increase in the number of species. As with other fresh-water fauna, there is a wide distribution of certain common species. Up to the present not a single example has yet been recorded from South Australia, though the streams of Mt. Lofty have been searched. In Western Australia a single specimen of *Simsonia tasmanica*, Bkbe., was taken by Mr. F. Lawson Whitlock in the Preston River, Bunbury district. The extension of the Tasmanian aquatic fauna to the south-west of the continent is consonant with the affinities of certain ants quoted by Mr. John Clark. That Mr. Whitlock worked with some diligence in the streams of his region was shown by his capture of numerous minute Hydrophilidae, Dytiscidae and a new species of Georyssus. Clearly, Dryopidae are uncommon west of the Murray River. Mr. Leathorn Wassell's researches around Brisbane; in the Pine River and Oxley Creek show the family to be extremely numerous. Three species, *Stenelmis pallidipes*, Cart., *Coxelmis v. fasciata*, Lea., and *Austrolimnius luridus*, C. & Z., were especially common, while two new species of *Austrolimnius* have rewarded his efforts. The most interesting of the new finds is the third recorded species of *Stetholus*, taken by Mr. F. H. Taylor in the Upper Shoalhaven River. Several larvae have been examined, but no evidence of their relation to the imagines of the same district has been shown. The possessors of aquaria could carry out a valuable research in the study of the physiology and life-history of these curious beetles. Four new species are described and figured below.

STETHOLUS LATICEPS, n.sp.

Elongate oblong; head, prothorax and elytra subnitid brown; abdomen and underside of legs red, upper surface of legs yellow, antennae with two basal segments yellow, the rest brown.

Head very wide, eyes very large and very prominent; surface pubescent, antennae relatively longer and less transverse than in *S. elongatus*; 1st segment long, stout and curved; 2nd widely oval; 3-4 triangular, much narrower than 2nd; 5-10 of gradually increasing width; 11th longer than 10th oval. Maxillary palpi having apical segment less elongated than in *elongatus*.

Prothorax at apex much narrower than head, widest at base, thence lightly narrowing to apex, with feeble sinuations in front and behind, apical part closely embracing prosternum, hind angles somewhat explanate and subacute, base bisinuate, disc with faint transverse line at apical third, two wide longitudinal sulci at base, surface punctate, with pale pubescence especially at base and sides.

Elytra wider than prothorax at base and thrice as long; subparallel, shoulders rather prominent; striate-punctate, the striae lightly impressed,

(1) Aust. Zool., 1929.

seriate punctures round and close, intervals flat and rather thickly punctate and pubescent.

Legs moderately long and slender, tarsi more slender than in *S. elongatus*.

Dimensions: 5 x 1.5 mm.

Habitat: New South Wales, Tallong, Upper Shoalhaven River (Mr. F. H. Taylor).

We are indebted to Mr. Taylor for 5 examples of this interesting find. It is conspecific with *S. elongatus*, C. & Z., by the characteristic short prosternum, the wide antennae and palpi. The eyes are round and extend wholly beyond the front edge of pronotum. The prothorax is rather longer and without the transverse sulcus of *elongatus*. The prosternum is wider than in that species and sparsely nodulose, its process is without a carina and bluntly rounded behind. The tibiae are grooved as if for the reception of the tarsi.

Holotype in Coll. Carter.

AUSTROLIMNIUS ATRICEPS, n.sp.

(Fig. 6.)

Elliptic, head black, prothorax, elytra and underside red, surface opaque, antennae and tarsi testaceous.

Head, eyes not prominent, forehead with sulci extending backward behind eyes.

Prothorax longer and flatter than in other species, widest behind middle, thence very lightly narrowed each way, apex emarginate, produced in middle, hind angles rectangular, wide lateral explanation delimited by carinae, the marginal one finely serrulate, medial sulcus wide, not quite reaching apex, surface lightly asperate.

Elytra obovate, margins finely serrulate, the two exterior carinae closer than in *A. politus* or *montanus*, all carinae less raised than in those species; seriate punctures close, intermediate in size between those of *politus* and *montanus*, intervals minutely wrinkled and asperate.

Prosternum longer, narrower, with more sinuate sides than in other species, its narrowed apex squarely rounded, its border raised, surface finely asperate; metasternum minutely punctate, abdomen finely pubescent.

Dimensions: 1.7 x 0.7 mm.

Habitat: S. Queensland, Pine River (Mr. Leathorn Wassell).

Seven examples sent. The species is distinct, not only by colour, but by its more elongate, depressed form, different sculpture and characters indicated above. Holotype in Coll. Carter.

var. *concolor*.

One example, inseparable otherwise from the others, has its whole upper surface opaque, black, and deserves varietal distinction by name.

AUSTROLIMNIUS VARIABILIS, n.sp.

(Fig. 8.)

Elliptic, yellow to dark brown above, underside brown, antennae and tarsi testaceous—in the darker examples the femora and sometimes the tibiae also dark colour; in the pallid examples the legs are concolorous with the upper surface.

Head subvertical, enclosed in prothorax to the eyes, the width here equal to that of the apex of prothorax; eyes large, antennae slender, extending nearly to base of prothorax.

Prothorax subconic, widest at base, thence for a short way subparallel, then arcuately narrowed and deflected towards apex, this convex in surface and outline; front angles lightly produced, the posterior angles rectangular; lateral margins finely serrulate; disc with fine medial sulcus, not quite extending to apex; the usual carina separating a wide foliation from disc; surface minutely asperate.

Scutellum oval.

Elytra slightly wider than prothorax at base, ovate or lightly obovate, lateral margins serrulate throughout, the usual lateral carinae present; seriate punctate, the serial punctures small, round and well separated; intervals flat with some microscopic ground punctures. Underside very finely punctate, the prosternal process wide, its sides straight.

Dimensions: 1.1 x 0.5 mm.

Habitat: Queensland, Pine River, Petrie district (17 miles N.W. of Brisbane), Mr. L. Wassell.

Another of Mr. Wassell's discoveries shows a minute, narrowly ovate species that is close in form, size and structure to *Neosolus tropicus*, C. & Z. We are unable to distinguish the dark from the pallid examples by any structural character. These were taken in company. Holotype in Coll. Carter. Seven examples examined.

N.B.—The above species has led us to a reconsideration of the genus *Neosolus*, which we now think insufficiently differentiated from *Austrolimnius*, and should be eliminated as a synonym.

Austrolimnius luridus, C. & Z. By an oversight the dimensions of this species were omitted from our Monograph (p. 63). These are 1.2-1.4 x 0.6-0.7 mm.

NOTRIOLUS MINOR, n.sp.

Obovate, subnitid black; antennae and tarsi red.

Head partially enclosed in hooded thorax, antennae with four apical segments slightly wider, longer and of darker colour than the preceding, apical longest.

Prothorax, apex and base bisinuate, apical half strongly convex, widest behind middle, thence very lightly converging to the prominent subacute front angles, more evidently narrowing behind, posterior angles obtuse; foliate margins moderately wide, widening to apex; disc evenly punctate (less so than in *allynensis*, Cart.), a light transverse depression near base.

Elytra obovate, considerably wider than prothorax at base; with distinct subhorizontal margin on basal half, gradually obsolete behind, extreme border finely denticulate, especially towards apex; elytra separately rounded at apex; striate-punctate, the serial punctures round, much larger than in *allynensis*, becoming smaller posteriorly, intervals nearly flat, sparsely punctate, with a few transverse ridges on basal area.

Underside with medial area coppery brown, the rest with a paler felt-like clothing; prosternum coarsely punctate, its process with raised borders, nearly straight, lightly narrowed to its subtruncate apex.

Dimensions: 3.5 x 1.5 mm.

Habitat: New South Wales, Dorrig (W. Heron).

Two examples examined are clearly distinct in their genus, near *N. allynensis*, Cart., but abundantly distinct by smaller size, narrower form, straighter prothorax, and much coarser seriate punctures of the elytra.

Holotype in Coll. Carter.

DESCRIPTION OF PLATE XII.

1. *Notriolus minor*.
2. Sternal process of *Notriolus minor*.
3. *Stetholus laticeps*.
4. Sternal process of *Stetholus laticeps*.
5. Antenna of *Stetholus laticeps*.
6. *Austrolimnius atriceps*.
7. Sternal process of *Austrolimnius atriceps*.
8. *Austrolimnius variabilis*.
9. Sternal process of *Austrolimnius variabilis*.

The small figures indicate the actual size of the specimens

REVIEW.

NATURE FANTASY IN AUSTRALIA.

By Alec. H. Chisholm. London. J. M. Dent & Sons, Ltd.
(Sydney, Angus & Robertson, Ltd.). 1932. (16/6).

Once more Alec. Chisholm presents us with a charming nature narrative, and this time, recognising the value of specialisation, he gives us a pen picture of the natural beauties of a restricted area—the Hawkesbury Sandstone Area. It may be that his previous books have contained more varied pictures, but this one shows how much there is to be discovered by the trained observer in the immediate vicinity of his own home. Roaming over the ridges and descending into the gullies of the sandstone, the author shows us how and where to find the birds and flowers of the sandstone country, and how to distinguish the few areas where the Wianamatta shale influences the vegetation, and consequently the flora and the birds feeding in its branches. This study of the interrelation of soil, vegetation, and fauna is not only fascinating in itself, but is an indispensable adjunct to the wider study of nature in general. While in this book we meet with some of the friends of previous works, here we find them framed in surroundings familiar to all metropolitan dwellers, and so described and located as to make the book a valuable guide to the local bush lover. The section devoted to the Cuckoos—"the World's Strangest Parents," is a concise description of the parasitic habits of the numerous varieties of Cuckoo frequenting Sydney and suburbs, and the questions as to the origin and object of these habits furnish subject matter for ingenious theory. The book is profusely illustrated by photographs taken by the author and his naturalist friends.—A. F. B. H.

THE BEES OF AUSTRALIA.

By T. D. A. COCKERELL.

(Continued from vol. vii., part i., p. 54.)

HALICTIDAE, subfamily HALICTINAE.

The Halictidae are spread all over the world, wherever it is possible for bees to exist, and the number of species is enormous. Most of them have been referred to the genus *Halictus*, but this may be divided into a number of subgenera, and there will no doubt be an increasing tendency to elevate these to generic rank.

NOMIOIDES Schenck.

A genus of small bees, found in Europe, Asia and Africa, with one species extending to Australia. In the Australian fauna it is easily known by its small size (female about 5 mm. long, male about 4 mm.), the head and thorax shining bluish-green, the abdomen piceous, with yellow markings. The female clypeus is light yellow, with two broad black bars, which are sometimes practically obsolete.

Nomioides perditella Cockerell.

Described from the female, taken in the Mackay district by Turner. In 1925 (Stett. Ent. Zeit., 86, p. 71) Bluthgen gave an elaborate description of the male. Friese, in 1924, redescribed it as *Halictus (Nomioides) obliquus*. Its nearest relative is *N. valdezi* Cockerell, from the Philippine Islands.

PARASPHECODES F. Smith.

This genus was established by Smith in 1853, who remarked that the species resembled *Sphecodes* in a general way, but the females had the characteristic caudal rima or furrow of *Halictus*. The males, as is common in *Halictus*, have an elongated abdomen, with the clypeus produced and yellow at the apex. The venational character (first recurrent nervure meeting second intercubitus) relied on by Smith is not constant. The hind spur of the hind tibiae in the female lacks the prominent spines or teeth often seen in *Halictus*. It was considered that all the species had the abdomen red or reddish, but it now appears that there is a series of entirely black forms, which can by no means be separated generically from the others.

Thus we are compelled to conclude that *Parasphcodes* has very little basis as a genus distinct from *Halictus*; but as it is confined to Australia, with a long series of species, and has a characteristic appearance, it seems best to retain it. Smith described a number of species, using anagrams of the word *Halictus* for the names. Dr. Reinhold Meyer revised the genus, recognising 51 species, in Archiv. f. Naturgeschichte, December, 1920. He gave tables for the determination of the species, but actually he had only a small series before him, and had to depend mainly on the literature. At present we know 17 species from Queensland, one (*P. vau* Ckll.) from N.W. Australia, two from W. Australia, five from South Australia, nine from New South Wales, 27 from Victoria, 24 from Tasmania, and three from Australia without more definite locality. These statistics require modification to the extent of stating that two of the Victorian species extend up the coast into Queensland. In general, however, the species seem to be of limited range. The great concentration of species in Victoria and Tasmania suggests that the genus belongs to the ancient Australian fauna, in this respect contrasting strongly with *Nomioides*. The genus is a difficult one to study, owing

to the large number of closely allied species, and the fact that so many are known only in one sex. Much larger series than have yet been collected, with field observations, are necessary in order to put the subject on a sound basis.

I have proposed (1930) a subgenus *Aphalictus* for *P. bribiensis* Ckll. and *P. bribionsiformis* Ckll. The females have a brown abdomen, with bosses on the first two tergites.

The following key to the species in my collection may be used to supplement those already published:—

- Abdomen black, or (*P. atrorufescens*) so dark reddish as to appear black 1.
- Abdomen black, slightly stained with red; mesothorax red *callomelittinus* Ckll.
- Abdomen distinctly red, at least in part 9.
- 1. Area of metathorax large, without plicae 2.
- (Area large, with very fine striae on basal half . . *paramelaenus* Ckll. = *tamburinei* Fr.)
- Area of metathorax with plicae, at least at sides 4.
- 2. Area shining on apical half; tegulae very dark *atronitens* Ckll., females.
- Area dull 3.
- 3. Larger; tegulae black or almost *plorator* Ckll., female.
- Smaller; tegulae red *insculptus* Ckll., female.
- 4. Male; clypeus chrome yellow, except a large quadrate black mark on each side above; antennae very long, entirely black; second sternite elevated *cervicalis* Ckll.
- Male; clypeus with a broad pale yellow apical band . . *infrahirtus* Ckll.
- Females 5.
- 5. Abdomen very dark red on first three tergites; first recurrent nervure not meeting second intercubitus; second abdominal sternite with a large conical tubercle *atorufescens* Ckll.
- Abdomen broadly dark reddish on first two tergites apically; first recurrent nervure meeting intercubitus *fulviventris* Frieze.
- Abdomen black 6.
- 6. Mesothorax with white hair; shining rim of metathoracic area continuous, not evidently depressed or broken in middle; stigma rufous *dissimulator* Ckll.
- Mesothorax with black hair 7.
- 7. Apical half of abdominal venter with black hair; tegulae black; first tergite with only a very narrow smooth margin. *fumidicaudus* Ckll.
- Apical half of abdominal venter with silvery white hair 8.
- 8. Punctures of first tergite, though very fine, going nearly to margin; area of metathorax very short, the plicate part a transverse band; tegulae black; stigma very dark *cervicalis* Ckll.
- First tergite with a rather broad apical smooth band; area of metathorax not so short; swollen second sternite very hairy *noachinus* Ckll.
- 9. Tegument of scutellum clear red 10.
- Tegument of scutellum not red 11.
- 10. Mesothorax entirely clear red; first three tergites light red, the others black, contrasting *aurantiacus* Ckll.
- Mesothorax more or less dusky or black; abdomen dark red to apex *tooloomensis* Ckll.

- (The var. *musgravei* Ckll. has the female head, mesothorax and metathorax entirely black, while the scutellum and postscutellum are clear bright ferruginous; the prothorax is red; abdomen with basal half dark reddish, apical half black.)
11. Scutellum and postscutellum densely covered with fulvous tomentum; abdomen light red, dusky apically; tibiae and tarsi light red or more or less darkened 12. (See also *P. vau* Ckll.)
Scutellum and postscutellum not so covered 15.
 12. Area of metathorax dull, weakly sculptured 13.
Area of metathorax apically shining 14.
 13. Larger; first three tergites clear to apex *bryotrichus* Ckll.
Smaller; first three tergites dusky apically. *bryotrichus sordidulus* Ckll.
 14. Middle and hind femora clear red, or mid femora dark
. *basilautus* Ckll.
 15. Thorax above with fulvous hair; tegulae ferruginous; second cubital cell short *fultoni* Ckll.
(*P. cirriferus* Ckll., with fourth and following tergites black, is allied.)
Hair of thorax above not fulvous 16.
 16. Males 17.
Females 22.
 17. First tergite black in middle, except at apex 18.
First tergite not black in middle 19.
 18. Larger; abdomen conspicuously hairy; first recurrent nervure meets second intercubitus *froggatti* Ckll. (topotype.)
(Compare here *P. perustus* Ckll., from Tasmania; red of abdomen very bright.)
Smaller; abdomen not hairy; first recurrent nervure reaches third cubital cell; tegulae red *rufotegularis* Ckll.
(Compare *P. tripunctatus* Ckll., with tegulae red; first recurrent nervure meeting intercubitus; a deep sulcus between first and second tergites.)
 19. Area of metathorax hardly sculptured; second sternite elevated into a large low tubercle *arciferus* Ckll.
(Closely allied is *P. fulviventrus* Friese, the abdomen very dark.)
Area of metathorax coarsely sculptured 20.
 20. Second sternite of abdomen elevated into a large mammiform tubercle; first three tergites chestnut red, those beyond black, contrasting *hybodinus* Ckll.
Second sternite not thus tuberculate 21.
 21. First tergite somewhat blackened in middle; flagellum red beneath *froggatti* Ckll.
First tergite not at all blackened in middle; flagellum all black.
. *vermiculatus* Ckll.
 22. Second sternite elevated into a conspicuous tubercle; base of abdomen black *arciferus* Ckll.
(Compare *P. fulviventrus* Friese, with a conspicuous tubercle, but abdomen very dark.)
(In two other species the second sternite is gibbous; they separate thus:
Abdomen black at base
. *arciferus* Ckll. (see also *fulviventrus* Friese.)
Abdomen not at all black at base 1.

1. Tegulae pure black; first recurrent nervure meeting intercubitus *wilmattae* Ckll.
Tegulae reddish; first recurrent joining apex of second cubital cell *leptospermi* Ckll.)
Second sternite not elevated into a tubercle 23.
23. Base of abdomen more or less narrowed, the first tergite not shouldered; abdomen reddish brown, not chestnut red; first two tergites with shining bosses laterally; tegulae fulvous (subgenus *Aphalictus*) *bribiensis* Ckll.
First tergite wide, shouldered; the red a chestnut colour. 24.
24. Base of abdomen black or strongly blackened 25.
Base of abdomen not blackened 28.
25. Wings very strongly reddened (somewhat so in *latissimus*); tegulae dark rufous *wellingtoni* Ckll.
Wings not reddened 26.
26. First tergite black only in middle; first recurrent nervure reaches second cubital cell well before end; area of metathorax dull, with merely fine rugose sculpture *wellingtoni griseipennis* Ckll.
First tergite very broadly black 27.
27. Much larger; red of the broad abdomen dark; wings rather reddened *latissimus* Ckll.
Smaller; red of the abdomen bright; tegulae rufous *excultus* Ckll.
28. Mesothorax moderately shining in middle; tegulae black; recurrent nervure meeting intercubitus *wilmattae* Ckll.
Mesothorax dull; tegulae usually more or less reddened. 29.
29. Tegulae clear fulvous red; wings very red *rhodopterus* Ckll.
(*P. speculiferus* may have the tegulae quite red, but wings not red, and area of metathorax shining apically.)
Tegulae not thus fulvous red 30.
30. Smaller; second cubital cell narrow or not very broad; area of metathorax shining apically *speculiferus* Ckll.
Larger; second cubital cell very broad 31.
31. More robust; first two tergites dark red, dull *lichatus* Smith.
Less robust; first two tergites clear red, moderately shining *leptospermi* Ckll.

The following key separates some species of the *P. cirriferus* group, with fulvous or ochraceous hair on thoracic dorsum:

- Males 1.
Females 3.
1. Flagellum red beneath *notescens* Ckll.
Flagellum black 2.
2. Fifth tergite black; black marks at sides of third and fourth tergites; hind tibiae black *fultoni* Ckll.
Fifth tergite reddish; no black marks at sides of third and fourth; hind tibiae dull red *rufulus* Friese.
3. Front and middle tibiae dusky red; fourth tergite dusky red *notescens* Ckll.
Front and middle tibiae black, more or less marked with red. 4.
4. Fourth tergite practically black, with red hind margin; third with red hind margin, contrasting with blackish area before it *fultoni* Ckll. (type.)
(In *P. cirriferus* Ckll., the fourth and following tergites are black.)

- Fourth tergite red 5.
5. Red of abdomen rather bright chestnut; wings clearer . . *fultoni* Ckll.
 Red of abdomen dark; wings dark *subfultoni* Ckll.
- The following was published in 1910:
- First recurrent nervure entering second cubital cell; flagellum red above and beneath *schomburgki* Ckll.
- First recurrent nervure meeting intercubitus 1.
1. Tibiae and tarsi red; clypeus partly red (females) or yellow (males) 2.
- Tibiae and tarsi mainly dark 4.
2. Scutellum and postscutellum densely covered with ochraceous moss-like hair 3.
- Scutellum and postscutellum without such hair *sextus* Ckll.
3. Abdomen dark reddish, tergites 3 and 4 about the same colour; first tergite with a reversed black V *vau* Ckll.
- Abdomen bright chestnut red, in female wholly black beyond third tergite; no V on first tergite *basilautus* Ckll.
4. Larger; general colour of thoracic hair ochreous or fulvous *cirriiferus* Ckll.
- Smaller; general colour of thoracic hair white 5.
5. Larger; hind legs more hairy *froggatti* Ckll.
- Smaller; hind legs less hairy *vulneratus* Ckll.

The following key, based on the types in British Museum, separates Smith's species:

Males.

- First recurrent nervure entering basal corner of third cubital cell; size smaller; abdomen red, with only the apex slightly blackish; flagellum entirely black *sulthica* Sm.
- First recurrent nervure joining second cubital cell not far from its end 1.
1. Flagellum ferruginous beneath; size rather large; a black cloud on third tergite and tergites 4 to 6 all black; area of metathorax coarsely wrinkled *altichus* Sm.
- Flagellum entirely black 2.
2. Area of metathorax rugose-granular; middle femora very dark. *stuchila* Sm.
- Area longitudinally plicate; middle femora clear red . . *hilactus* Sm.
- (*P. talchius* Sm., male, not in the British Museum, was seen at the Hope Museum, Oxford. The area of metathorax has close-set thick obtuse rugae, the sculpture not prominent; abdomen dullish; antennae very long, entirely black; first recurrent nervure falling a little short of second intercubitus; hair of head and thorax above ochreous.)
- (A male *P. hilactus* in the Oxford collection was observed to have a triangular yellow mark on clypeus above the very broad yellow band; area of metathorax with fine striae, and in some lights the appearance of a transverse ridge; abdomen stout, shining between the punctures. From F. Smith's collection.)

Females.

- First recurrent nervure entering second cubital cell near apex; red of abdomen quite bright; area of metathorax often without longitudinal ridges or wrinkles 1.

- First recurrent nervure meeting second intercubitus; red of abdomen darker or duller; area with longitudinal ridges or wrinkles 3.
1. Abdomen red, only faintly blackened apically; area dull, without distinct wrinkles or ridges; second cubital cell higher than broad *lithusca* Sm.
Abdomen with tergites 1 to 3 red, 4 and 5 black 2.
 2. Smaller; red of abdomen very bright, hind margins of tergites 1 and 2 darker; clypeus with few large punctures on a shining surface; second cubital cell about as high as broad *tuchilus* Sm.
Larger; red of abdomen darker, chestnut colour, hind margins of tergites 1 and 2 not darkened; area with a delicate raised sculpture; second cubital cell very broad, broader than high, and nearly as large as third *lichatus* Sm.
 3. Larger; abdomen shining very dark chestnut, blackened apically; ridge behind area of metathorax very prominent; second recurrent nervure and third intercubitus much weakened *tilachus* Sm.
Smaller; abdomen not so dark 4.
 4. Area with fine wrinkled ridges; abdomen dull and rather hoary; second cubital cell about square *lacthius* Sm.
Area with fine straight ridges 5.
 5. Wings strongly yellowish *taluchis* Sm.
Wings clear *hiltacus* Sm.

Parasphecodes adelaidae Cockerell.

Female about 9 mm. long; in the table of Smith species runs to *P. tuchilus* and *P. lichatus*, but distinct by the very dark and shining abdomen, wherein, as also in the weakened outer nervures, it resembles rather *P. tilachus*. Adelaide; type in British Museum. The following table will also be useful:

- Abdomen smooth and shining; hind legs clear red . . *adelaidae* Ckll.
Abdomen less shining; hind legs not red 1.
1. Vertex and mesothorax above with much black hair . . . *lichatus* Sm.
Vertex and mesothorax not thus 2.
 2. Abdomen black beyond third tergite *loweri* Ckll.
Fourth tergite red *tepperi* Ckll.

Parasphecodes altichus Smith.

Tasmania. Male only known.

Parasphecodes anhybodinus Cockerell.

Cheltenham, Victoria (F. E. Wilson). Male about 10 mm. long; allied to *P. hybodinus*, but elevation of second sternite much less pronounced, and red of abdomen much darker. They agree in the shining snow-white hair on inner side of hind tarsi.

Parasphecodes annexus Cockerell.

Adaminaby, N.S.W. (A. J. Turner). Female a little over 7 mm. long. A table separating this from other species is given in Mem. Queensland Museum, vii. (1922), p. 257.

Parasphecodes arciferus Cockerell.

Mordialloc, Victoria (F. P. Spry). The male, from Melbourne (H. Edwards) is described in Psyche, June, 1930, p. 151. The antennae are long and black; legs black.

Parasphecodes atronitens Cockerell.

Caloundra, Q. (Hacker). Also Nanango district. Female about 9.5 mm. long; close to *P. plorator*, but wings not so dark, and first two tergites finely punctured.

Parasphecodes atrorufescens Cockerell.

Purnong, Victoria (S. W. Fulton). For characters, see table above.

Parasphecodes aurantiacus Cockerell.

Brisbane, Q. (Hacker). Known by the entirely orange-fulvous thorax.

Parasphecodes basilautus Cockerell.

Kuranda, Q. (Turner); type in British Museum. *Halictus pilicollis* Friese, from Cairns, is a synonym.

Parasphecodes bribiensiformis Cockerell.

Bribie I., Queensland (Hacker); type in Queensland Museum. Female resembles *P. bribiensis*, but area of metathorax much larger, subtriangular, with coarse though irregular plicae; tegulae piceous with a red spot (fulvo-testaceous in *P. bribiensis*). Belongs to subgenus *Aphalictus*.

Parasphecodes bribiensis Cockerell.

Bribie Island, Q. (Hacker); also Stradbroke I. Type of subgenus *Aphalictus*. Female about 8 mm. long. A table comparing it with similar species of *Halictus* is given in Mem. Queensland Museum, v. (1916), p. 201.

Parasphecodes bryotrichus Cockerell.

Cheltenham, Victoria (French). Thorax above with fulvous moss-like hair.

Parasphecodes bryotrichus sordidulus Cockerell.

Brisbane, Q. (Hacker). For characters, see table above.

Parasphecodes callomelittinus Cockerell.

Melbourne (C. French); also Bribie I., Q. Type in British Museum.

Parasphecodes carbonarius (Smith).

Sydney. A black species, described by Smith under *Halictus*.

Parasphecodes cervicalis Cockerell.

Eaglehawk Neck, Tasmania (Turner); type in British Museum. Both sexes were taken by Hacker in the National Park, Queensland. The male is described in Mem. Queensland Museum, vii. (1922), p. 258. The male has the mesothorax glaucous; abdomen entirely black.

Parasphecodes cirriferus Cockerell.

Victoria (C. French); type in British Museum.

Parasphecodes contaminatus Cockerell.

Kuranda, Q. (Turner); type in British Museum. Metathorax and abdomen rufofulvous.

Parasphecodes dissimulator Cockerell.

Carrom, Victoria (French). For characters, see table above.

Parasphecodes excultus Cockerell.

Magnet, Tasmania (Arthur M. Lea); also Mt. Wellington (R. E. Turner). A table separating this from other species is given in Ann. Mag. Nat. Hist., July, 1914, p. 52.

Parasphecodes frenchi Cockerell.

Melbourne (French); type in British Museum. Female about 9 mm. long; abdomen very dark chestnut red, beyond second tergite strongly

blackened, sides of second and third tergites each with a triangular basal patch of white tomentum.

Parasphecodes froggatti Cockerell.

Bathurst, N.S.W. (Froggatt); type in British Museum. For characters, see table above.

Parasphecodes fultoni Cockerell.

Croydon, Victoria (S. W. Fulton). *Halictus rubriventris* Friese, from Ararat, Victoria, is the same species.

Parasphecodes fulviventris (Friese).

Melbourne. Female very close to *P. arciferus*, with the same large tubercle on second ventral segment of abdomen, but larger and more robust, with the abdomen very dark, and the stigma much darker.

Parasphecodes fumidicaudus Cockerell.

Stradbroke I., Q. (Hacker); also Bribie Island.

Parasphecodes gibbosus (Friese).

Sydney, N.S.W.; in Meyer's table runs to *P. tepperi*, differing (female) by the robust form and black flagellum. *P. speculiferus* has a brighter red abdomen, and entirely different area of metathorax. Friese's male is *P. subrussatus*. See Amer. Museum, Novitates, 343 (1929), p. 15.

Parasphecodes grandis Meyer.

Tasmania; type in Berlin Museum. Male 11 mm. long. Tergites 1 to 3 red, the rest black; flagellum clear red beneath; wings somewhat dusky apically.

Parasphecodes hilactus Smith.

Swan River, W.A. Male. Smith also reports it from Adelaide. Clypeus yellow at apex; abdomen black beyond third tergite, and first three with fuscous margins.

Parasphecodes hiltacus Smith.

"New Holland." Female. Abdomen red, the base and sides with a hoary pubescence.

Parasphecodes hirtiventris Cockerell.

Ebor, N.S.W. (A. J. Turner). Related to *P. arciferus* and *P. leptospermi*. Female about 10 mm. long. Fourth tergite entirely black (red in *P. annexus*).

Parasphecodes hybodinus Cockerell.

Windsor, Victoria (French). Male about 10 mm. long; first three tergites (except apex of third) bright chestnut red; beyond this the tergites are black, with the hind margins dark brown. A table separating this from other species is given in Ann. Mag. Nat. Hist., February, 1912, p. 225.

Parasphecodes infrahirtus Cockerell.

Launceston, Tasmania (F. M. Littler). *Halictus obscuripes* Friese, male from Adelaide, is the same species.

Parasphecodes insculptus Cockerell.

Mount Tambourine, Q. (Hacker). For characters, see table above.

Parasphecodes insignis Meyer.

Tasmania; type in Berlin Museum. Female 9.25 mm. long; tergites 1 to 3 red, the rest black; wings clear. Falls in Meyer's table next to *P. lichatus*, but with second cubital cell higher than broad.

Parasphecodes lacthius Smith.

"New Holland." Female. Abdomen red, first tergite more or less fuscous at base; fourth and following tergites fuscous, with thin hoary pubescence.

Parasphecodes latissimus Cockerell.

Bridport, Tasmania (Littler). For characters, see table above.

Parasphecodes leptospermi Cockerell.

Brisbane, Q. (Hacker). Female about 9.5 mm. long. Allied to *P. speculiferus*, but known by its large size and black apical tergites. Also near to *P. hybodinus*.

Parasphecodes lichatinus Cockerell.

Ararat, Victoria (Davey). Female about 10 mm. long; wings darker than in *P. lichatus*. Apical part of abdomen with black hair dorsally. Flagellum red beneath.

Parasphecodes lichatus Smith.

Western Australia. Female. Abdomen red, with the fourth and following tergites black. Thorax strongly and very closely punctured. Taken by Nicholson at Eradu and Kojarena, W.A. Rayment records it from Swan River (L. J. Newman).

Parasphecodes lithusca Smith.

Tasmania. Female. Wings reddish-hyaline, clouded apically; legs rufotestaceous.

Parasphecodes longmani Cockerell.

Caloundra, Q. (Hacker). Differs from *P. subrussatus* by the light ferruginous tegulae.

Parasphecodes loweri Cockerell.

Adelaide; type in British Museum. For characters, see table above. Female about 9.5 mm. long; first three tergites chestnut red, the others black; the first with a blackish anchor-shaped mark.

Parasphecodes melbournensis Cockerell.

Female about 11 mm. long; area of metathorax broad, without a shining rim, its surface dull and minutely roughened, the basal two-fifths covered with little ridges; abdomen bright red, first tergite largely clouded with blackish, extreme apex blackish. Melbourne. Type in British Museum.

Parasphecodes microdontus Cockerell.

Melbourne (C. French); type in British Museum. Female about 8 mm. Sides of metathoracic truncation above with a tooth-like projection.

Parasphecodes minimus Meyer.

Port Philip; type in Berlin Museum. Male 7 mm. long; tergites 1 to 3 red, beyond that the abdomen is black, except that the fourth has a red band; tergites 1 and 2 are brownish in middle; wings clear.

Parasphecodes nigritus Meyer.

Tasmania; type in Berlin Museum. Male 10.5 mm. long, black, including abdomen. A light mark on clypeus.

Parasphecodes noachinus Cockerell.

Ararat, Victoria (W. F. Hill). Female 11 mm. long. In Meyer's table it runs next to the smaller *P. carbonarius*.

Parasphecodes notescens Cockerell.

Beaconsfield, Victoria (F. E. Wilson); type in Queensland Museum. Closely related to *P. fultoni*, the male easily distinguished by the flagellum red beneath (all black in *P. fultoni* and in *P. rufulus*), and the female by the red anterior and middle tibiae. Length about 9 mm.

Parasphecodes perustus Cockerell.

Mt. Wellington, Tasmania (Turner); type in British Museum. Red of abdomen very bright; tegulae red. A table to separate this from other species is given in Ann. Mag. Nat. Hist., July, 1914, p. 52. Meyer separates it from *P. sextus* and *P. recantans* by the red fourth tergite.

Parasphecodes plorator Cockerell.

Melbourne (French); type in British Museum. Also at Croydon, V., and Mt. Wellington, T. It was found at Jenolan, N.S.W., at flowers of *Helichrysum lucidum* by W. P. Cockerell.

Parasphecodes punctatissimus Meyer.

Tasmania; type in Berlin Museum. Judging from the description, this seems to be *P. fultoni*.

Parasphecodes punctatissimus niveatus Meyer.

Tasmania; type in Berlin Museum. Tergites 2 and 3 with white hair-spots at sides of base; legs all black, except a little yellow on knees.

Parasphecodes recantans Cockerell.

Victoria (French); type in British Museum. Male about 8 mm. long. A table separating this from other species is given in Ann. Mag. Nat. Hist., February, 1912, p. 225. Meyer separates it from *P. sextus* by the third tergite dark at end.

Parasphecodes recessus Cockerell.

Mt. Wellington, Tasmania (Turner); type in British Museum. Area of metathorax plicate only basally (strongly plicate all over in *P. turneri*). Female about 9 mm. long.

Parasphecodes rhodopterus Cockerell.

Launceston, Tasmania (Littler). Female about 8 mm. long; allied to *P. taluchis*, but antennae and legs black.

Parasphecodes rufitarsus Rayment.

E. Gippsland. Female 11 mm. long. The hind spurs have short noduliform teeth.

Parasphecodes rufocollaris Cockerell.

National Park, Queensland (Hacker). Female about 7.5 mm. long; head and thorax black, but prothorax, tubercles and tegulae bright ferruginous; abdomen dark brownish red stained with blackish, beyond the third tergite practically black. Allied to *P. bribeensis*.

Parasphecodes rufotegularis Cockerell.

Launceston, Tasmania (Littler). Male 8.5 mm. long; black, with the broad apical margin of first tergite (extending basad at sides), and the second and third tergites entirely, very bright ferruginous; tegulae bright ferruginous; antennae black.

Parasphecodes rufulus (Friese).

Victoria. Male resembles *P. fultoni*, but truncation of metathorax not polished, but sculptured all over, though moderately shining. Tegulae rufufulous; antennae black.

Parasphecodes schomburgki Cockerell.

Adelaide (Schomburgk); type in Berlin Museum. Female about 8.5 mm. long. Meyer comments on this species in his revision.

Parasphecodes sextus Cockerell.

Adelaide (Schomburgk); type in Berlin Museum. Male 9 mm. long. Tergites 1 to 3 red; legs partly clear red.

Parasphecodes solis Cockerell.

Brisbane (Hacker). Abdomen wholly chestnut red; tubercles entirely black. A table separating this from other species is given in Mem. Queensland Museum, vii. (1922), p. 257.

Parasphecodes speculiferus Cockerell.

Victoria (French); type in British Museum. Goes north to Brisbane. A new description is given in Mem. Queensland Museum, v. (1916), p. 201. The typical form has the tegulae rufo-fuscous; the var. a. (from Sydney, N.S.W., at *Angophora* flowers) is larger, female almost nine mm. long, the tegulae piceous.

Parasphecodes stuchila Smith.

Tasmania. Male. Abdomen ferruginous, basal half of first tergite black; apex of clypeus yellow.

Parasphecodes subfultoni Cockerell.

Victoria (E. Wilson); type (female) in Queensland Museum. Very near *P. fultoni*, but tegulae rufous (not the clear rufo-fulvous of *P. fultoni*); wings blackish, unusually dark, with darker stigma and very dark nervures; abdomen very dark red, the same colour throughout.

Parasphecodes submeracus Cockerell.

Stanthorpe, Queensland (F. A. Perkins); type in Queensland Museum. Female a little over 9 mm.; basal nervure very strongly bent, and ending a long distance from nervulus; abdomen very broad, dull dark red, black beyond third tergite.

Parasphecodes submoratus Cockerell.

Russell Falls, National Park, Tasmania (A. J. Turner). Female about 7.6 mm. long; abdomen chestnut red.

Parasphecodes subrussatus Cockerell.

Kosciusko (A. J. Turner); Friese's male of *Halictus gibbosus*, from "Kosciusko" (R. Helms), is the same. The female *H. gibbosus* is another species.

Parasphecodes sulthica Smith.

"New Holland." Male. Abdomen red, slightly fuscous at apex; face covered with fulvous hair.

Parasphecodes talchius Smith.

Tasmania. Male. Apex of clypeus yellow; abdomen black at base, and apex more or less fuscous.

Parasphecodes taluchis Smith.

Tasmania. Female. Abdomen red, slightly fuscous toward the apex. The smallest species described by Smith.

Parasphecodes tamburinei (Friese).

Mt. Tambourine, Queensland (Mjöberg).

P. paramelaenus Ckll., collected by Hacker in the National Park, Queensland, is a synonym. A table separating this from other species is given in Mem. Queensland Museum, vii. (1922), p. 257.

Parasphecodes tepperi Cockerell.

Adelaide; type in British Museum. Female about 9 mm. long; abdomen noticeably narrower than in *P. loweri*, and head shorter. Abdomen entirely red, the apex faintly blackish.

Parasphecodes tilachiformis Cockerell.

New South Wales; type in American Museum of Natural History. Female about 8 mm. long. Abdomen much darker than in *P. tilachus*, with much more abundant though prevailing shorter hair; legs black.

Parasphecodes tilachus Smith.

Tasmania. Female. Abdomen red, fourth and following tergites black.

Parasphecodes tooloomensis Cockerell.

Tooloom, N.S.W. (Hacker). Female closely related to *P. aurantiacus*, but mesothorax posteriorly black, only the broad anterior portion red; area of metathorax wholly or largely black; apical part of abdomen red. The wings are strongly dusky.

Parasphecodes tooloomensis musgravei Cockerell.

National Park, Macpherson Range, Q. (A. Musgrave); type in Australian Museum. For characters, see table above.

Parasphecodes tripunctatus Cockerell.

Ararat, Victoria (G. F. Hill); type in American Museum of Natural History. Male about 9 mm. long; abdomen with first three tergites bright chestnut red (first with a dusky T-mark), the others black or reddish black, the fourth with a transverse red band (as in the considerably smaller *P. minimus*); a deep constriction between first and second tergites.

Parasphecodes tuchilas Smith.

"New Holland." Female. Abdomen red, the extreme base black, as also the fourth and following tergites.

Parasphecodes turneri Cockerell.

Eaglehawk Neck, Tasmania (R. Turner); type in British Museum. Both sexes are separated from other species in a table in Ann. Mag. Nat. Hist., July, 1914, p. 52. Female about 8.5 mm. long, male about 8 mm.

Parasphecodes vau Cockerell.

N.W. Australia (C. French); type in British Museum. For characters, see table above.

Parasphecodes vermiculatus Cockerell.

Victoria (from G. F. Gill). For characters, see table above. I took it at Beaumaris, Victoria, March 31, at flowers of *Achillea*.

Parasphecodes vulneratus Cockerell.

Victoria (C. French); type in British Museum. For characters, see table above.

Parasphecodes wellingtoni Cockerell.

Mt. Wellington, Tasmania (R. Turner); type in British Museum. Disc of mesothorax polished.

Parasphecodes wellingtoni griseipennis Cockerell.

Found near the Jenolan Caves, N.S.W., by W. P. Cockerell. For characters, see table above. At flowers of *Helichrysum lucidum*, April 29.

Parasphecodes wilmattae Cockerell.

Found near the Jenolan Caves, N.S.W., by W. P. Cockerell. For characters, see table above. Taken at flowers of *Helichrysum lucidum*, April 29. Approaches *P. gibbosus*, but area of metathorax much shorter, and not broadly squared off behind; red of abdomen brighter.

Parasphecodes zamelanus Cockerell.

Dunally, Tasmania (G. H. Hardy); type (male) in Queensland Museum. Entirely black, except for the yellow clypeus, with the sides above black, the black areas uniting above, the upward extension of yellow ending in a sharp point. Near *P. cervicalis*, but larger (length about 11 mm.), and with different venation.

In the above list, I give some descriptive details, especially concerning species described since Meyer's revision appeared, but the student must in every case consult the complete descriptions for purposes of identification. From this paper he can only establish probabilities of identity, or, in a number of cases, ascertain that species are *not* identical with those before him.

"IMPRISONING" THE LYRE-BIRD'S SONG.

Zoologists, generally, and probably a large number of the public, will welcome the announcement that the melody of Australia's famous Lyre-Bird (*Menura*) has been captured on a gramophone record, a feat which stands to the credit of Mr. R. T. Littlejohns, of Melbourne, working in conjunction with Herschell's Pty., Ltd. Mr. Littlejohns, one would say, thoroughly deserves his success in this enterprise. He laboured long and arduously in other years before securing a motion picture giving glimpses of the male disporting and the female at the nest; and he followed this up last year by producing a sound-film recording the male bird's medley of mockery. A brilliant representation, for the most part, this sound-film (as many Sydney people will remember) was slightly marred by a curious "bump" which developed at intervals in the song, due, apparently, to some undetected fault in the recording equipment. This year, therefore, Mr. Littlejohns and his assistants went afield again, and this time they secured what is described as a perfect sound-film. It is from this that the gramophone record has been made. In view of the fact that Mr. Littlejohns is quite satisfied with the record, it seems manifest that it is, indeed, worthy of the brilliant fantasia itself, and is one which every naturalist will wish to possess. The record is to be issued by Herschell's very shortly at a moderate price. One side of the disc will be devoted to the "concert," and the other to a description of the bird and its habits.—A. H. CHISHOLM.

A REVISION OF THE RABBIT-BANDICOOTS.

Family PERAMELIDAE, Genus *Macrotis*.

By ELLIS LE G. TROUGHTON.*

(Zoologist, Australian Museum.)

In view of the consistent omission of New South Wales from the range of the rabbit-bandicoots, in which recent authors appear to have followed the British Museum Catalogue of 1888, I assembled the Australian Museum material several years ago with the intention of identifying the local race and recording various localities within the State; notes were made, but pressure of routine made it impossible to complete the work. The rapid shrinkage in the range of the local form is relevant to my current Presidential Address, and, as the characteristics of the race should be available for co-workers, it is proposed to deal with them in relation to allied forms, after tracing some early records, and stabilising the generic name.

It is surprising that though Reid described the first rabbit-bandicoot in 1837, wrongly localised as Tasmania and actually from south Western Australia, their occurrence in New South Wales was apparently not recorded until 1864, in Krefft's "Catalogue of the Mammalia in the Australian Museum." In this first reference, Krefft listed an adult female from the Lower Murray, gave the name used by aborigines of the Lower Darling as "Jacko," and included the "interior of New South Wales" in the habitat. In 1866, his paper on "The Vertebrates of the Lower Murray and Darling" (1), reiterated the aborigines' names as "Wuirrapur (Murray natives)," and "Jecko (Darling tribes)," and stated that "This beautiful animal, like many other species, has long ago retreated to the north of the Murray." The first edition of his "Australian Vertebrata" (2) gives the range as "principally the plains of the interior, from the Lower Lachlan and Murrumbidgee to West Australia." In the second edition Krefft (3) refers to fossil remains of living species of *Perameles* being taken at Wellington [caves], New South Wales, and states that "A few remains of the *Peragalea* were also obtained; the teeth are larger and slightly different from the *Peragalea lagotis* of the present day." In his "Mammals of Australia," also of 1871, the habitat was given as "New South Wales, Northern Victoria, South Australia, Queensland, and West Australia."

The listing by Lydekker in 1887 of portions of a maxilla and mandible in the British Museum, with molars in situ, "from a cave in the Wellington Valley," apparently provides the only other authentic record of rabbit-bandicoots in New South Wales; the material was "Presented by the Trustees of the Australian Museum, 1870," and probably represented the "remains" referred to by Krefft of which, unfortunately, nothing seems to have been retained for our Museum. The habitat of "*Peragale lagotis*" was given by Lydekker as "Western Australia (recent), and New South Wales (pleistocene)," which may have led Thomas to suppose that the rabbit-bandicoot was no longer living in the eastern State, thus possibly

* Contribution from the Australian Museum.

(1) Krefft, Trans. Phil. Soc. N.S.W., 1862-1865 (1866), 14.

(2) Krefft, Cat. Nat. Industr. Prod. N.S.W., 1867, in Offic. Rec. Intercol. Exhib. Melbourne, 1867, appendix, 405 (57).

(3) Krefft, Industr. Progress of N.S.W. (Rept. Intercol. Exhib. 1870), iii., 1871, 21.

explaining his action in the "Catalogue," where the habitat was given as "South and West Australia" only, although he listed two of Krefft's references, as well as Lydekker. This omission of the eastern State misled subsequent authors, and so we find New South Wales excluded from the range of the genus by Ogilby in his Catalogue of 1892, Baldwin Spencer in the Horn Report of 1896, and all systematic and popular works.

It was indeed unfortunate that Ogilby, a brilliant ichthyologist, should have been commissioned to prepare the "Catalogue of Australian Mammals," issued by the Australian Museum. He evidently made a mere compilation without reference to the fascinating collection already in the Museum, thus providing an excellent example of the need for specialisation, which has since become an essential part of museum practice. The omission of local records by Ogilby is rendered more surprising by the fact that in the year preceding his Catalogue a splendid adult male rabbit-bandicoot was received from Bathurst, about 100 miles west of Sydney, presented by Dr. Machattie in September, 1891; other material then in the collection included skulls and skeletons from "Moolah," Mossgiel, presented by the owner of the property, Mr. K. H. Bennett, in 1879-1880, a skin and skull of a female from Coombie, collected by Messrs. Bennett and Adam in 1883, and another complete specimen from Illabo, between Cootamundra and Junee Junction, in 1886.

Since 1892, fifteen specimens reached the Museum, making in all at least twenty-two, of which the last was received from Moree in June, 1908; though several are not definitely localised, there is no doubt that the entire series came from within New South Wales. Fortunately, only three specimens have been exchanged abroad, leaving series of nine skins and sixteen crania for examination. Probably never very plentiful, the rabbit-bandicoot was apparently distributed fairly evenly west of the dividing range in the early days, and, unless mere coincidence, appears to have been more abundant in some years as three specimens reached the Museum in August, 1897, and again in 1903. There seems no doubt, however, that the local race has vanished from the more settled areas, and that, as Wood Jones found in South Australia, the Bilby is rapidly disappearing from New South Wales, or is at least faced with a precarious existence in more desert regions. I am not aware of pelts ever having been marketed to any extent in Sydney, as at the skin sales in Adelaide, but no doubt numbers have been killed in rabbit traps, and wantonly for so-called sport, while foxes must be contributing to the apparent annihilation within New South Wales.

The last record of the Bilby's occurrence in New South Wales, so far as I am aware, is provided by my colleague, Mr. K. C. McKeown, who had a pair under close observation in the rocky hills on the Wagga Experimental Farm for about five years prior to 1912, when they were unfortunately slaughtered by shooters from the town, to the intense regret of his father, then manager of the farm. The number never seemed to increase, only two ever being seen, which probably lived in crevices or shared the rabbit warrens amongst the rocks. According to Mr. McKeown, they were not very shy and were about at almost any time during the day; he adds that during a long association with the Murrumbidgee Irrigation Area he never saw a Bilby on or near that area, which would appear to have been a stronghold for them in the past.

In stating that there certainly is no part of South Australia in which the Bilby is not a rapidly disappearing animal, Wood Jones expresses sur-

prise at the decrease of numbers in the centre, where the animal is little molested by man and where he considers the fox to be still absent or rare, and suggests that the great abundance of rabbits and resultant struggle for breeding burrows may be responsible. My own experience when collecting in very dry country about Farina, South Australia, in 1919, was that foxes were very numerous and already tending towards a small lean desert type capable of entering the larger rabbit burrows without difficulty, and doubtless those of the Bilbies as well.

Krefft referred to the rabbit-bandicoot as not being gregarious, a pair only occupying a burrow, and to having procured but a few, amongst which was a female with two large young in the pouch. According to Wood Jones, one or two constitutes the usual litter, although there are eight teats, and it seems possible that a reduced rate of breeding, in the less hospitable regions to which settlement is forcing them, where the cunning introduced enemy probably now abounds, must ultimately lead to the extinction of this harmless, picturesque, and pest-destroying marsupial.

In his comprehensive "Review of the Rabbit-Bandicoots," afterwards included in the "Handbook," Wood Jones described a new species, *Thalacomys nigripes*, and originated cranial features to differentiate the known forms. Emphasising the need for large series in determining specific characters of mammals, he referred to the recognised variability of animals inhabiting the more central regions, and to the possibility that further material might invalidate some of the conclusions, which were thus tentative in some respects. As forecasted, examination of sixteen crania from New South Wales show the cranial features relied on to be variable beyond a degree of specific value in races intergrading in size.

In regard to the extraordinary variability which renders characterisation of the large races especially difficult, consideration of the wide range accorded some forms in relation to the various types of country shown on the recent C.S.I.R. vegetation map (4) suggests that much of the variation, particularly in size, represents natural reaction to environment. The shrinkage in the range of once widely distributed forms is apparently evolving distinctive geographical races, which will become more marked with isolation in the unlikely event of survival under the prejudicial conditions of to-day.

The New South Wales series appears to represent a geographical race of *lagotis*, and a thorough comparison with typical western and intermediate material invokes drastic rearrangement of the larger forms of the genus. In offering the following conclusions, based upon intergradations of character and range, full acknowledgment is made to Professor Wood Jones for so admirably reviewing and figuring the known forms against the time when additional material should be available.

It is not practicable to summarise Professor Wood Jones' thorough account of the bionomics of the genus, beyond emphasising that the ones observed were far more carnivorous than any other bandicoots (*Isodon* or *Perameles*) that he had studied in captivity. The Professor also stated that the tolerance shown towards the Bilbies by early colonists was due to recognition of the fact that in the destruction of mice and insects, rabbit-bandicoots were very useful animals. In this regard alone, it is indeed unfortunate that the depredations of the introduced fox, the poison-cart, and

(4) Prescott, Council Sci. Ind. Research, Bull., No. 52, 1931.

the actions of thoughtless or ill-informed people, should have swept this interesting and useful creature from the settled areas of New South Wales.

It is considered advisable to review the complicated synonymy at length as some indication of the immense amount of taxonomic work to be done towards stabilising many mammal names. In doing so, I wish to acknowledge indebtedness to Mr. Tom Iredale for his helpful advice; also to Mr. G. P. Whitley, who kindly prepared the distribution map. Sincere thanks are due to both colleagues for that ever-ready exchange of views which is the very essence of the stimulating and pleasant side of museum research.

Genus MACROTIS.

1837. *Macrotis* Reid, Proc. Zool. Soc., 131 (Ot. *Perameles lagotis* Reid).
1838. *Thylacomys* Owen, Athenaeum, London, No. 572, Oct. 13, 747 (n. n.).
1840. *Thalacomys* (err. pro *Thylacomys* Owen), Blyth, Cuvier's Anim. Kingd., 104 (teste Palmer). Haplotype *Macrotis lagotis* (Reid).
1841. *Paragalia* Gray, in Grey, Journ. Two Exped. Austr., app. ii., 401. Haplotype *Macrotis lagotis* (Reid).
1843. *Perigalea* Gray, List. Mamm. Brit. Mus., xxii.
1843. *Paragalea* Gray, *ibid.*, 96. and as "Peragalea" (vernacular only).
1845. *Peragalea* Gould, Mamm. Austr., pt. 1, pl. xii (vide Waterhouse), also vol. i., pl. vii. (bound), ex Gray, 1843 (vernacular).
1846. *Macrotis* Waterhouse, Nat. Hist. Mamm., i., 358 (*Peragalea* Gray cited, p. 360).
1854. *Phalacomys* (wording ex Blyth-Cuvier), English Cyclopaedia, Nat. Hist., i., 382. Typographical error only.
1887. *Macrotis* Jentink, Cat. Ost. Leyden Mus., 305.
1887. *Peragale* Thomas, Ann. Mag. Nat. Hist. (5), xix., 397-9; Id., Lydekker, Cat. Foss. Mamm. B.M., pt. v., 1887, 256; Id., Thomas, Cat. Mars. Monotr. B.M., 1888, 221; Id., Waite, Ann. Mag. Nat. Hist. (7), ii., 1898, 196 (note).
1899. *Thylacomys* Palmer, Ann. Mag. Nat. Hist. (7), iv., 300-2.
1900. *Thalacomys* Thomas, *ibid.*, v., 223 (note).
1904. *Macrotis* Palmer, Index Gen. Mamm., 394-5 ("preoccupied by *Macrotis Dejean*").
1904. *Paragalia* Palmer, *ibid.*, 513 ("antedated by *Thylacomys* Owen").
1904. *Thylacomys* Palmer, *ibid.*, 677.
1906. *Thalacomys* Thomas, Proc. Zool. Soc., 475 (footnote).
1907. *Thylacomys* Elliot, Publ. Field. Col. Mus., Zool. Ser., viii., 10.
1923. *Thalacomys* Wood Jones, Rec. South Austr. Mus., ii., 3, 339, and Handbook Mamm. South Austr., pt. 2, 1924, 152.

History and Synonymy.—The generic name of the rabbit-bandicoots has probably been subject to more confusion than that of most marsupials, and, as the comments of such eminent authors as T. S. Palmer and the late Oldfield Thomas left an invalid name in use, it seems desirable to traverse the complicated history with a view to stabilising the authentic name for this interesting genus.

In 1837, Reid, when describing *Perameles lagotis*, provided the sub-genus *Macrotis* in view of the marked distinction between it and the other species of *Perameles*. These differences were emphasised by Owen (1838, P.Z.S.) in comparison with other forms, in which the name *Perameles* was employed throughout, but a new generic name had been proposed during

the reading for the rabbit-bandicoot, which was made clear by a brief report in the London Athenaeum, stating that Mr. Owen "proposed the new genus *Thylacomys* for certain species presenting a peculiar conformation of the cranium." The name was carefully omitted from the published work, but Owen evidently overlooked the formal press report of the Zoological Society's meeting, and there is no doubt that *lagotis* was the form referred to.

In 1840, Blyth used *Thalacomys* on the authority of Owen, and, though this was a misprint for the *nomen nudum* of the Athenaeum, Thomas (1900) utilised Blyth's spelling and later disagreed with Palmer's (1904) objection that it was an "obvious misprint." Thomas argued (1907) that we are not justified in calling *Thalacomys* a misprint when it was the second name occurring, as if corrected, and "was again twice repeated by its author in subsequent editions." The value of these arguments, however, is nullified by the facts that "*Thyla*" (pouch) was frequently used in combinations of marsupial names by Owen, whom Blyth was quoting, and that the several editions of Blyth's work were stereotyped, so that repetition had no significance whatever. On checking back the English Cyclopaedia (1854), Mr. Iredale found the name printed *Phalacomys*, another misprint, and actually the second time the name had been independently published.

In 1841, Gray introduced the name *Paragalia*, which has been subjected to far greater varieties of spelling than Owen's debated name, and which was actually started by Gray himself in 1843, when in one work he provided the vernacular name "Peragalea," and twice spelt his generic name differently to its original form.

Gould (1845), utilising the vernacular "*Peragalea*" generically, refers to *Macrotis*, but after remarking that Reid minutely described the dental and external characters of *Perameles lagotis*, which were considered by him to be typical of a distinct genus, Gould then surprisingly states that "he did not, however, publish any generic characters," and adopts Gray's name for the rather fantastic reason that "the term *Macrotis* is objectionable from its similarity to the specific name."

In 1846, Waterhouse cites Gould's work, but gives *Macrotis* priority as a subgenus of *Perameles*, after which the name lapsed from general use, due rather to Gould's action than, as suggested by Palmer, to the later supposition than Dejean's Coleopteran name invalidated it.

In his Catalogue (1888) Thomas quoted the vernacular name *Peragalea* as Gray's generic one, and wrongly referred it to Gray's original reference for *Paragalia*. In 1887, Thomas had amended the vernacular name to *Peragale*, and, in a footnote in the Catalogue to support its use, throws doubt on the existence of Owen's *Thylacomys* by the erroneous suggestion that Blyth's version of it was based upon a confused account of Gray's *Thylamys* = *Didelphys*, for an American opossum. The name *Peragale* was then employed until the use of *Thylacomys* by Waite for a rodent led to conflict of opinion between Palmer and Thomas on the relative merits of Owen's and Blyth's names, in which the claims of *Macrotis* were overlooked on the supposition that previous use in entomology by Dejean (1833) rendered it untenable.

Though I am unable to examine Dejean's first edition, Sherborn (5) states his *Macrotis* to be a *nomen nudum*, a view which has the coin-

(5) Sherborn, Index Animalium (2), xv., 1928, 3777.

currence of Iredale, who has seen the work, while the name is not in use amongst Coleopterists, and apparently never has been accepted by them. Reference to the third edition (1837), in the library of the Linnean Society of New South Wales, clearly demonstrates that *Macrotis* Dejean is a *nomen nudum*. In view of the invalidity of Dejean's name there appears to be no doubt that *Macrotis* of Reid is the correct generic name for the rabbit-bandicoots of the family *Peramelidae*.

Review of Diagnostic Characters and Geographical Range.

Cranial Characters.—The main ones figured and tabulated in his summary by Wood Jones are (1) the relative extension of the hind margin of the palate in relation to M4, (2) size and position of the palatal vacuities in relation to the dentition, and (3) the extension of the nasalia posteriorly in relation to a line joining the lachrymal foramina.

(1) The extension of the palate beyond the last molar is not so marked in the local specimens, or my Western Australian skulls, as in the South Australian one figured by Wood Jones, and, though it may be a characteristic of the *Nalpa* skulls, the local series shows the feature to be variable and subject to growth change; several young females have the palate terminating at M4, as figured for *sagitta*, suggesting that the feature may be misleading in a small series. However, the distance between molar and palate-end is well-marked in an aged male of the local series, the distance being almost equal to that figured by Wood Jones.

(2) The relative position and size of the palatal vacuities is very variable. In seven skulls with basal lengths from 80.5-88 mm., including two females, one of which is aged, the hind edge does not surpass the anterior border of M3; in nine others ranging from 87.5-96 mm., males and females, the rear margins just surpass the front edge of M3, and in only one of the sixteen crania does the condition almost exactly approximate that regarded as typical of *lagotis*, in which the hind margin is in line with the mid-point of M3. The anterior margin of the vacuities varies in origin from the front edge to the middle of Pm3, the vacuities being exceptionally long in some individuals.

(3) The nasalia are strikingly variable in the sixteen crania, both in contour and width, and particularly in the relation of the hind edge to the inter-lachrymal line, showing the character to be quite unstable as a diagnostic one in regard to the various races. In a fully adult Western Australian male the nasals do not approach the line as closely as figured by Wood Jones, while an adult female from the same locality shows a space of 4 mm., thus equalling the condition figured for *nigripes*. In the sixteen New South Wales crania only four have the nasal margin almost touching the inter-lachrymal line, figured as typical of *lagotis*, while in the rest the dividing space ranges from 2-4 mm.; that any phase is not typical of either sex, or the eastern or western forms, is shown by the fact that in two adult (N.S.W.) males of similar palate length one has the nasals almost in contact with the line between the foramina, the other an intervening space of 4 mm., as in the Western Australian female. It is thus clear that the feature is not of diagnostic value.

Cranial variation embracing two characters dealt with above is found in a young adult, basal length 83 mm., which has the nasals almost touching the inter-lachrymal line, as shown for *lagotis*, and the palate terminating at M4, as given for *sagitta*; this palatal condition in New South

Wales specimens certainly seems to be due to age, but it suggests the possibility that aged specimens of *sagitta*, if long series were available, might show the reverse condition, tending to intergradation.

The crescentic molar rows, said to be typical of *lagotis*, in which the palate is rounded posteriorly, appear to be accentuated by age, owing to the splaying outward of the molars, the resultant pressure considerably increasing the breadth outside M3. Growth to the aged condition produces a striking change in the molars; with growth upwards and wear, the length of the inner edge is reduced and its median notch disappears, while the whole tooth is greatly expanded outwards. The extent of this change is well shown by a young adult and aged female (N.S.W.) of similar basal length, in which the transverse width of M2 is 4.8 and 7.2 respectively, and the width outside M3 is 24.2 against 28.8 mm.

External Characters.—In the composite *lagotis*, unfortunately, the neutral body coloration provides no definable features to characterise the various races, leaving the relative extent of the black and white of the tail, and the dark hairing of the sole, except in *nigripes*, as the only and very variable colour characters. The proportions of the black and white areas of the tail are rendered unstable, both by natural variation and the secondary factor that the length of the hairs beyond the actual tip is especially variable and affected by wear, thus nullifying the diagnostic value of the feature in *lagotis*. In *minor*, however, restriction of the black hairs to a dorsal band, instead of an encircling one, differentiates the species from the small races of *lagotis*, while the wholly white tail of *leucura* is unique in the genus.

The coloration of the pes appears to supply a diagnostic external feature, in so far as whiteness above and below characterised the holotype of *leucura*, and the blackness *nigripes*, but the use of the mere relative extent of the dark mark on the sole to differentiate *lagotis* and *sagitta*, both having the pes white above, is not justified. The instability of the dark sole-mark is further shown in that the specifically distinct *minor* has the pes-coloration agreeing with that of *lagotis*.

It may be noted that Thomas regarded the black sole-mark as variable, stating in the Catalogue that the soles were "white distally, but the latter colour replaced by black in very old specimens." The feature is certainly very variable as a pair from Rawlinna, Trans-Australian Railway, shows the male with the blackish hairs continuing to the large pad, as in my local and South-west Australian specimens of *lagotis*, while in the female the dark line is very slight, though extending for more than the posterior third, said to be typical of *sagitta*. The relative extent of the dark sole-mark is therefore too slight and variable for use as a diagnostic character.

The naked area extending backward from the rhinarium is an obviously variable feature in *lagotis*, caused by thrusting or rooting in the ground for food, so that its relative extent is not of diagnostic value. Its absence, however, in *leucura* and Spencer's series of *minor*, supported by other differential characters, suggests a difference in habits in the two smaller species.

Geographical Range.—Regarding *lagotis*, Wood Jones has corrected the inference to be drawn from Thomas' 1905 paper that the species was restricted to Western Australia, pointing out that it was the familiar species of Bilby in the more fertile areas of South Australia a comparatively short time ago. The habitat of *sagitta*, according to Wood Jones, could not be considered typically South Australian, but as representing the genus in the more arid central region, the view therefore being that the range of the

two species did not overlap. The specimen recorded by Finlayson (6) from near the Musgrave Ranges as *lagotis* seemed to conflict with the idea that the typical western form was absent from the more central region. Later, the same author (*ibid.*, lv., 1931, 161) records specimens of *Thalacomys lagotis* from 120 and 150 miles north-east and north-west of Alice Springs respectively, and withdraws his suggestion, founded on the Musgrave Range female, that the Central *lagotis* is a dwarfed form. As Finlayson concludes that variation in the adult size is sufficient to embrace all the Central *lagotis*, it may be inferred that the ranges of the large western and smaller south-central races overlap to a far greater extent than previously supposed.

Whatever the identity of the Musgrave Ranges female, its relationships are complicated by specimens from Rawlinna, south-east Western Australia the dimensions of which intergrade perfectly with those of *sagitta* and *nigripes*, but having the extension of the vacuities and hind margin of the palate typical of the true *lagotis*; the adult male has the posterior extension of the nasalia about intermediate between *lagotis* and *sagitta*, and the female has the space between the nasalia and the inter-lachrymal line equaling that in *nigripes*. In both characteristics and geography, therefore, the Rawlinna specimens appear to represent a race intermediate between the central *sagitta* and the large western race, to which the Musgrave Ranges specimen apparently belongs.

Following on this intergradation of the western and central races, and progressing eastward, one notes the Gilles Plains, Eyres Peninsula, specimen listed by Wood Jones, the main cranial dimensions of which agree well with both the extreme western and eastern races of *lagotis*, and finally there is the Nalpa series, from south-east of Adelaide, with a basal length of skull greater than any other race.

Summary.

Analysis of the above appears to indicate that there is but one variable species of rabbit-bandicoot, excluding the much smaller and well characterised *leucura* and *minor*, ranging from inland New South Wales to coastal Western Australia, which is represented by several smaller intervening semi-desert races, with the extremes of east and west paralleling development to a striking degree. This construction is born out by a study of the C.S.I.R. Vegetation Map, which shows the intermediate Rawlinna specimens to inhabit desert-fringing country very similar to that four hundred miles eastward where *nigripes* occurs; the intervening desert areas, and smaller though intergrading forms, seeming effectively to separate the larger eastern and western races inhabiting the more fertile areas indicated on the map.

Though in some instances the extraordinary variability in the New South Wales crania is due to age, the varying conditions may be expected to occur in the smaller forms of intermediate range, thus involving their specific status. It is notable that the correct range of basal length of *nigripes* skulls is 72.5-81, according to the description, not 80-81, as tabulated in the Revision summary and listed in the Handbook. As a result of this alteration, the basal length of *sagitta* overlaps the *nigripes* minimum by 4 mm. The basal length of the slightly larger Rawlinna race intergrades with *nigripes*, but is smaller than the minimum measured for the typical south-western *lagotis*, though overlapping the minimum of young adults from New South Wales.

(6) Finlayson, Trans. Roy. Soc. South Austr., liv., 1930, 178.

It is also notable that Wood Jones' summary of specific characters shows the pes coloration tending to ally *sagitta* and *lagotis*, and that of the tail *sagitta* and *nigripes*, while the habits when in the burrow tend to ally the three forms.

In view of the puzzling intergradation and variability which apparently renders specific distinction impossible, it seems advisable to regard *sagitta* and *nigripes* as geographical races of *lagotis*, and to constitute new subspecies for the intervening and terminal eastern races, in the hope of defining their confusing interrelationship.

1. MACROTIS LAGOTIS LAGOTIS.

Perameles (Macrotis) lagotis Reid, Proc. Zool. Soc., 1837, 129-131. Swan River, south Western Australia.

Diagnosis.—A large race with a very long, comparatively sparse, silky coat, consisting mostly of underfur, the longer shining hairs being very sparse and soft. The colour of back near light mouse grey in the female, darker and more grizzled in the old male, darkened in the centre with brownish tipping, the whole suffused with a wash of the vinaceous buff which extends along the sides of the head and body and is warmest below the ear; on the hindquarters the buffy colour extends upwards over the hip, forming a stripe which is almost continuous with a buffy fringe of hair which extends across and along the base of the tail. Hair of face shorter and more woolly, the underfur paler, and a concentration of the brown colour on the centre and around the eyes. Fur of undersurface white to roots. Pes white above, dark sole-mark extending from heel to large pad. The black band of the tail usually longer than, or equalling, the white, well-haired and encircling the tail.

Skull large, basal length 87-94.8, opposed to 77-84.8 in nearest geographical race, the nasal width averaging less than in large allies, not exceeding 8 mm. Palatal margin extending well behind M4 in fully adult crania; the vacuities large, their hind margin extending beyond the front edge of M3. Teeth large, front of canine to back of M4 41-44, transverse width of M2 4.8-6.9 mm.

Considerably larger than the nearest geographical race at Rawlinna, on the edge of the Nullarbor Plain, but with a similar arrangement of the palate.

Habitat and Specimens Examined.—According to Shortridge in 1912, widely distributed over south and central Western Australia, eastward almost to a line with Kalgoorlie; extending to, or represented in, Central Australia, according to Finlayson. Specimens in the Australian Museum from Gracefield, by exchange with the Perth Museum; Coorigan, presented by Mr. A. S. Le Souef; Tenterden, collected by Messrs. E. Le G. Troughton and J. H. Wright. Type in British Museum.

2. MACROTIS LAGOTIS INTERJECTA, *subsp. nov.*

An intermediate race, somewhat smaller than the typical western one with which it is allied by palatal features, but with pes and cranial dimensions intergrading with the smaller races further to the east and centre. Fur shorter and more woolly than in typical race, the general colour more drab grey and less contrasting; fur of belly whitish to roots. Pes white above, the dark sole-mark extending to the large pad in the male and about half the distance in the female. Black portion of tail equalling, or shorter than, the white and completely encircling the shaft.

Hind margin of palate in adults extending well behind M4, and vacuities behind front margin of M3 as in typical race. Skull and teeth decidedly smaller; basal length 77-84.8, opposed to 87-94.8 in typical race, C-M4 34.8-38.7 against 41-44 mm.

Dimensions.—Allotype female and holotype male respectively (in the flesh): Head and body 303, 318; tail 207, 232; ear, from opening, 80, 82; pes 93, 98.5 mm.

Skull.—Basal length 77.7, 84.8; nasal length 37.8, 42.2; width 6.5, 7.5; palate length 52, 56.9; breadth outside M3 23.6, 23.7; front of canine to back of M4 34.8, 38.7; transverse width M2 4.1, 4 mm.

Habitat and Specimens.—Adult pair and young female from Rawlinna, Trans-Australian Railway, Western Australia, obtained in co-operation with Mr. A. S. Le Souef. The holotype and allotype registered M.4351 and M.4639 respectively, in the Australian Museum collection. It is possible that the Musgrave Ranges specimen recorded by Finlayson is an aged female of this race; cranial dimensions were unfortunately not given, but the pes length of 90 mm. is not reconcilable with the typical race (females 98-103), and allies it with the smaller more central ones.

Intermediate in size between its western ally and the small *sagitta*, and distinguished from *nigripes* by the white upper surface of the pes.

3. *MACROTIS LAGOTIS NIGRIPES*.

Thalacomys nigripes Wood Jones, Rec. S. Austr. Mus., ii., 3, 1923, 347-351, 3 figs. Around Ooldea Soak, Trans-Railway, South Australia.

An intermediate black-footed race, with dimensions intergrading with *interjecta* of the west side of the Nullarbor Plain, and *sagitta* of the more central region. General colour described as much as in true *lagotis*, being darker and more fawn-coloured immediately after the moult, and lighter and more silvery before; the body colour becomes darker upon the dorsal surface towards the rump, the tips of the long hairs posteriorly being black. Snout black from the naked portion to between the eyes, which are surrounded with black hairs. Ventral surface pure white. Tail with encircling black portion shorter than white. Manus black above the carpus and metacarpus, white over digits. From the ankle, the pes is entirely black above and below.

Skull fairly large, basal length 72-81, compared with 74-76.5 (*sagitta*) and 77-85 (*interjecta*); molar portion of palate slightly rounded but less than in *interjecta*, the breadth outside M3 averaging 20 opposed to 23.5 mm. Margin of palate extending well behind M4, but comparatively less than in typical race or *interjecta*; vacuities rather small, the hind border reaching to the anterior corner of M2. The molars were described as considerably smaller than those of *sagitta*, but the maximum length of C-M4 is the same, and barely 2 mm. less than this dimension in the somewhat larger *interjecta*.

Habitat.—All specimens examined by Wood Jones came "from a restricted area around Ooldea Soak," South Australia, on the east-west line, all being captured by aborigines around the Soak. Not uncommon.

Remarks.—Though this form is readily distinguished from all others by its black manus and pes, the intergrading of dimensions, variability of other features, and geographical location ally it with the other sub-desert races of *lagotis*. Females have not been examined; though the black manus and pes would doubtless prove consistent, the dimensions of females should further emphasise intergradation. The Ooldea district appears to possess a

fauna of its own, doubtless due to its rather unique situation on the fringe of the Nullarbor Plain, and the somewhat richer vegetation resulting from the presence of water in the region of the Soak.

4. *MACROTIS LAGOTIS SAGITTA*.

Thalacomys sagitta Thomas, Ann. Mag. Nat. Hist. (7), xvi., 1905, 426-7. Killalpaninna, east of Lake Eyre, South Australia.

The smallest race, but with the dimensions of pes, skull, and dentition intergrading with the sub-desert *nigripes* and *interjecta*. Regarding size, it is notable that Thomas, comparing it with typical *lagotis*, wrote that "Externally, apart from the corresponding difference in size, there is little to distinguish the two forms. On the whole, *Th. sagitta* is a little paler in tone, the black band on the tail is slightly shorter, being shorter instead of longer than the white end, and the feet are paler below, the black only extending about a third of their length underneath the heel."

Skull small, but basal length (74-76.5) and C-M4 (36-37) intergrading with those of *nigripes* (72-81 and 34.5-37 respectively). According to Wood Jones' specimens, the posterior portion of the palate is only slightly rounded and the molars are arranged in almost straight rows, diverging posteriorly; the posterior edge of the palate is described as terminating in line with M4, all of which features are reproduced in young adults of the extreme eastern and western races. Palatal vacuities apparently intermediate between *nigripes* and *interjecta*, their hind margin extending to about the mid point of M2.

Habitat.—Type locality Killalpaninna east of Lake Eyre; others from remains taken at Miller's Creek and Coward Springs (Wood Jones). This form was considered by Wood Jones to be restricted to the more arid central regions about the Lake Eyre basin and north towards Charlotte Waters. The C.S.I.R. Vegetation Map, however, indicates that a similar type of country extends south-west to the better type of country less than 100 miles north of Ooldea, thus bringing the race in contiguity with *nigripes*; the semi-desert area is shown due south to below Port Augusta, so that the range of *sagitta* may be, or have been, more extensive than supposed. It is possible that the Musgrave Ranges female may prove to be *sagitta*, thus considerably extending the range westward; the foot-length, however, equals that of the male holotype of *sagitta*, so that it may belong to the somewhat larger *interjecta*.

Remarks.—In view of the slender nature of the external characters, as recognised by Thomas, variability of cranial ones, intergradation of dimensions, and continuity of range with other sub-desert forms, there seems no doubt that *sagitta* represents a small desert race of the true *lagotis*, which attained its maximum size in the more fertile region south of Adelaide.

5. *MACROTIS LAGOTIS GRANDIS*, *subsp. nov.*

Diagnosis.—The largest race, the hind foot attaining a length of 114 mm., opposed to a maximum of 108 in an aged specimen of the typical western race, and 109.5 in a series of large and fully adult New South Wales males. Ears apparently much shorter in proportion to those of the small race, *sagitta*. Basal length also considerably larger in three skulls listed from Nalpa, from 103-105 mm., opposed to a maximum of 96 in the series of eastern and western races, and the large Lake Gilles specimen.

That the size is not merely individual is indicated by the nasal and palate lengths being very much in accord with the large specimens of the

next largest races; palatal vacuities therefore relatively very large, as they extend farther posteriorly than in the allied races, reaching quite to the centre of M3.

Habitat.—Nalpa, in the Lake Alexandrina District, south of Adelaide, South Australia.

Holotype.—Stuffed adult male in the Adelaide Museum from Nalpa, listed by Wood Jones as head and body 550; tail 260; hindfoot 114; ear 77 mm. Three paratype skulls with same data are listed by Wood Jones: a skull with intermediate C-M4 has the following dimensions:—greatest length 114; basal length 104; zygomatic breadth 56; nasals length 48; palate length 66; C-M4 44 mm.

Remarks.—A name has been afforded this apparently extinct race, with some hesitation, in view of the fact that differences noted doubtless reflect isolation in evidently favourable surroundings, the race therefore having an interesting bearing upon zoo-geographical distribution in southern Australia. It is significant in this regard, to note that one of the largest species of the widely ranging murine genus *Pseudomys* (*auritus*) was taken at Lake Albert in the same region.

In regard to the smaller foot length of the typical *lagotis*, it may be noted that Reid's measurement of 114 mm. evidently included the claw, thereby adding about 8 mm. to the usual measurement.

6. *MACROTIS LAGOTIS CAMERICA*, *subsp. nov.*

Diagnosis.—A large race, paralleling the extreme western typical form in size and general characteristics, but much larger than the intervening inland sub-desert races. The fur is shorter, closer, and more woolly than that of the typical race; above, the general colour is more fuscous owing to the predominance of the darker buffy wash and brown tipping, over the bluish grey of the western race. Undersurface yellowish, instead of clear white. Black portion of tail equal to or longer than white; dark hairing on sole extending to the large pad.

The hind margin of palatal vacuities rarely more than just surpasses the anterior margin of M3. Molar rows crescentic, and hind margin of palate extending well behind M4 in old specimens, but the reverse condition, as described for *sagitta*, is shown in a young adult female. Nasals averaging wider than in typical *lagotis*, ranging from 7.3-10 against 6.8-8 mm., the relative maxima being in old specimens of similar basal length; Pm4 also averaging larger, the length, 3.8-4.5 against 3.6-3.9.

Dimensions.—Allotype female and holotype male respectively (stuffed): Head and body 390, 500; tail 248, 278; ear, from opening, 81, 93; hindfoot 98, 109.5 mm.

Skull.—Basal length 81, c96; nasal length 42, 48.9; width 7.7, 10; palate length 54, 64; breadth outside M3 24.2, 32.9; C-M4 39.3, 44.4; transverse width M2 4.8, 7 mm.

Habitat.—According to Museum specimens, originally distributed over inland New South Wales from the Darling River (Bourke) in the west, across to near the Great Dividing Range in the east (Bathurst and Goulburn), south to the Murray River and north to the Queensland border (Moree); probably extending into southern Queensland, as represented by the "typical living specimen from Queensland," referred to by Wood Jones.

Holotype and Allotype.—Adult male from Bathurst, No. M.677; young adult female from Coombie, in the area about midway between Hillston and Cobar, No. A.18,586, both in the Australian Museum collection.

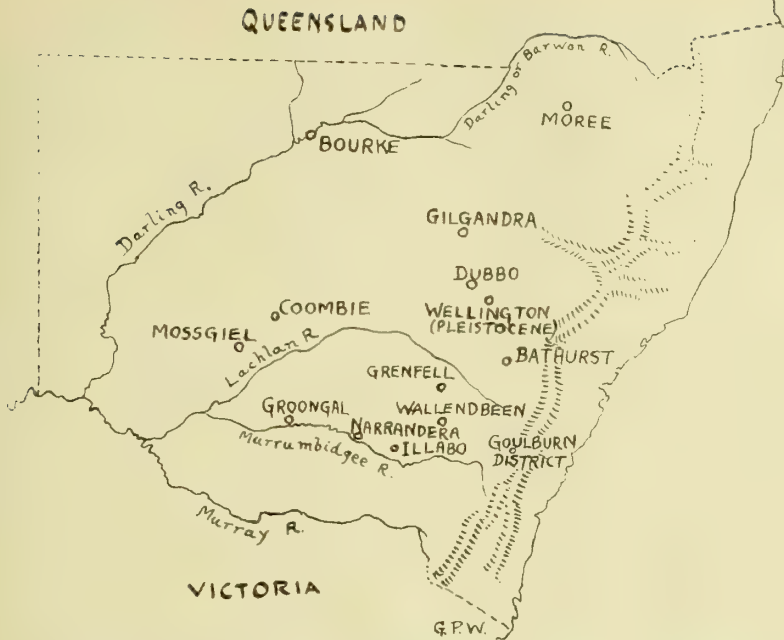


Fig. 1.—Map of New South Wales, indicating the past range of the Bilby, *Macrotis lagotis cambrica*, indicating the localities where specimens in the Australian Museum were taken.

Localities.—Mossgiel, Coombie, Groongal, Narrandera, Illabo, Wallendbeen, Grenfell, Goulburn, Bathurst, Dubbo, Gilgandra, Bourke, Moree, Wellington caves (pleistocene).

Remarks.—This race, intermediate in size between its nearest western and southern neighbours, *sagitta* and *grandis*, has evidently been present in New South Wales for a very long time, according to its once wide distribution, and the fossil remains found at Wellington; Krefft remarked that the fossil teeth were larger and rather different to recent ones, but this may be discounted by his probably not being aware of the marked growth changes, and the remains may reasonably be taken as indicative of the long establishment of the local race.

7. *MACROTIS MINOR*.

Peragale minor Spencer, Proc. Roy. Soc. Vict. (n.s.), ix., 1897, 6, pl. ii. figs. 1-4.

Thalacomys leucurus Le Souef (not Thomas), Australian Zoologist, vi., 2, 1930, 110.

Diagnosis.—A small species which differs from *sagitta*, the smallest race of *lagotis*, in its definitely smaller size, coloration of the undersurface and

tail,* and different habits. Analysis of Spencer's description provides the following general characteristics.

Colour and Fur.—Fur very long, soft, and silky; composed almost entirely of underfur. General colour fawn-grey; apparently darker than *sagitta*, which Thomas described as a little paler than the typical western *lagotis*. On the back and sides the underfur is black basally, then fawn-coloured; the stouter hairs are very little longer than the underfur, and black-tipped. On the undersurface, the chin and inner side of the forelimbs are white; rest of limbs and undersurface grey, the fur with a dark grey basal part and white distal half. Manus white. Pes white above, the hairs on the posterior two-thirds of sole black, white anteriorly. Tail with proximal two-thirds short-haired and black above, final third white-haired and crested dorsally; sides and undersurface of tail with scanty stiff white hairs.

External Characters.—Size small, the head and body length not attaining 300 mm.; the tail relatively short as in *sagitta*, averaging about two-thirds the length of the remainder, instead of five-sixths as in *leucura*. Rhinarium naked but no backward prolongation on the snout as in *lagotis*. Hindfoot decidedly smaller than in *sagitta*, ranging from 57-73 in the typical series of adults of both sexes, against 91 mm. in the adult male type of *sagitta*. A small rounded pad at the base of the fourth toe and a much larger one at the base of the fifth. Mammae 8.

Skull and Dentition.—Skull smaller and more delicate than in *lagotis*, the basal length of an adult male is 66 mm. against 76.5 in the adult male type of *sagitta*, the smallest race of that species. The upper anterior extremity of the premaxillary not so strongly produced as in *lagotis*, the muzzle therefore not appearing so markedly trifid antero-laterally. According to Spencer's figure, the posterior end of the palate extends well behind M4, the hind margin of the nasals is separated by about 4 mm. from the line joining the lachrymal foramina, and the molar portion of the palate is slightly rounded. Posterior palatal vacuities extending from about the middle of Pm3 to the hind edge of M2. These features, derived from a single example, are doubtless subject to a considerable degree of variation, as indicated under the genus.

Molars small, in slightly curved rows, with considerable spaces between the lingual margins of adjacent teeth. Front of canine to back of M4 28 mm., against 36 in *sagitta*.

Comparison with Allies.—Apart from its size, which is intermediate between *leucura* and the smallest race of *lagotis*, this species is distinguished from both by having the basal half of the belly fur dark grey, instead of white or yellowish-white to the roots. According to the description, *minor* is further distinguished by having the black tail-mark on the dorsal surface only, instead of encircling the tail as in *lagotis*, while the entire tail of *leucura* is white.

The Mungerian Specimen.—This was, in my opinion, incorrectly recorded as *leucurus* by Le Souef, and I am indebted to Mr. Brazenor, of the National Museum, for the following points, derived from his manuscript notes, which tend to ally the specimen with *minor*. The length of the head

* Since preparing the following description of *M. minor*, Mr. C. W. Brazenor, of the National Museum, Melbourne, has kindly examined the typical series and confirmed the distinctive characteristics of bi-coloured belly-fur, and restriction of black on the tail to a dorsal band.

and body suits the range given for *minor* and is considerably larger than that of *leucura*; that this is not merely due to age is shown by the relative shortness of the tail which agrees with *minor* in being about two-thirds the length of the head and body, instead of five-sixths as in *leucura*. A photo of the Mungeranie animal clearly shows the tail* to be parti-coloured, lack of which distinguishes *leucura*, while the brown mark on the posterior part of the sole agrees with *minor* rather than *leucura*, which is without dark hairing along the sole. The length of the skull (60 mm.), only 6 mm. less than listed for *minor*, and the length of C-M4, agree well with the latter, the size therefore being less than in *sagitta*, and considerably more than in *leucura*.

Distribution.—As only the typical series has been recorded, from the sandhills about forty miles to the north-east of Charlotte Waters, just north of the South Australian border, there is a tendency to regard *minor* as of a definitely more central range. As pointed out regarding *sagitta*, however, the range is probably more extensive than supposed, which is supported by the National Museum specimen, apparently reconcilable with *minor*, which comes from Mungeranie, east of Lake Eyre, only a little north of the type locality of *sagitta*.

Holotype and Allotype.—Only one specimen, adult male (e) of Spencer's list, has the skull removed, and this specimen, which is numbered R.12,430, with its skull as tabulated by Spencer, may definitely be designated as the holotype. Allotype, adult female (d) of Spencer's list, registered No. R.12,313. In the National Museum, Melbourne.

Remarks.—As was the view of Spencer, in which Thomas concurred, there can be little doubt of the specific distinction of *minor*, in support of which I now emphasise the restriction of the black on the tail to a dorsal band, and the bi-coloration of the belly-fur, characters not hitherto stressed, but, if consistent, serving to distinguish *minor* from all other forms. It is noteworthy that in his personal copy of the "Catalogue," which was thoughtfully placed at my disposal when working at the British Museum, Mr. Oldfield Thomas had pencilled "two specimens from Charlotte Waters, C.A., at once distinguished by tail black along top only for proximal half or two-thirds, in a narrow line or low crest, the sides dull whitish and the end of its long crest pure white." The feature was verified by the specimens, and it seems remarkable that its diagnostic importance was not stressed in Spencer's description.

Apart from differences of size and various features, the notes of Mr. Byrne, given by Spencer, showed the habits to differ from those of *sagitta*, and that this is recognised and exploited by the aborigines. The scanty white hairing of the undersurface of the tail, opposed to the thick encircling of dark hairs in *lagotis*, and the absence of the naked prolongation on the snout in the adult series, supports the inference of different diet and habits to those of the races of *lagotis*. As Thomas stated, *sagitta* is clearly the "Urgarta" which Spencer referred to the typical *lagotis*, in contrasting its habits and characters with those of *minor*, known to the aborigines as "Urpila."

The coincident range of the two forms, in conjunction with differences in size, characters, and habits, leaves no doubt of the specific distinction

* The dark dorsal band on the tail and the bi-coloured belly-fur are as in *minor*, but somewhat lighter, according to Mr. Brazenor.

from *lagotis sagitta*, but it is possible that *minor* may be subspecifically allied to *leucura*.

8. MACROTIS LEUCURA.

Peragale leucura Thomas, Ann. Mag. Nat. Hist. (5), xix., 1887, 397, and Cat. Mars. Monotr. Brit. Mus., 1888, 225, pl. ii. (animal), pl. xxi., figs. 9-10 (manus and pes).

Diagnosis.—Apparently the smallest of the genus, from all members of which it is distinguished by the wholly white tail, which is also proportionately longer, and by the wholly white pes which lacks a dark mark on the sole. Molars, according to Thomas, differing considerably from the true *lagotis*. Habitat: Central or North Central Australia.

Colour.—General colour uniform pale yellowish fawn. Top of head and back fawn, suffused with slaty grey, the hairs slate-coloured at the base and tipped with brown. Hairs of the muzzle, chin, chest, belly, limbs, and tail pure or yellowish white to the roots. Fore and hind limbs pure white, the pes without a dark mark along the sole.

External Characters.—Size small, form slender, the head and body length much smaller than that of females of *minor*, although the hindfoot almost equals the minimum for that series. Rhinarium hairless, but no naked prolongation on the snout. Tail proportionately very long, about five-sixths the length of the head and body; the hairs of the terminal third forming a prominent crest. Two small but distinct pads on the compound terminal projection opposite the 4th and 5th toes, closer and more like enlarged granules than those of *minor*.

Skull and Dentition.—Skull small and delicate compared with young *lagotis*, the general characters very similar, except that the bullae are more evenly hemispherical, and not so prominently bulbous postero-externally.

Teeth, according to Thomas, in comparison with an immature specimen of *lagotis* with unworn dentition, much smaller, but of similar shape and relative proportions. Molars small and quadrangular, their summits with numerous sharp-pointed cusps as in *Perameles*; their general structure therefore much more distinctly insectivorous than in *lagotis*; they also differ in the much earlier period at which they form roots, the roots of the two anterior molars being already formed and closed up in the very young holotype, while in *lagotis* the crowns are very long and the roots unclosed until quite late in life.

Comparison with Allies.—Although the holotype male was immature and the hindfoot-length approximates the minimum of females of *minor*, the nearest ally, it seems evident that *leucura* is distinguished by having the head and body proportionately smaller, the tail much longer, and by the coloration, in which the belly fur is uni-coloured, instead of bi-coloured, and the tail is wholly white instead of being black above for the dorsal two-thirds proximally; the wholly white pes also distinguishes it from all other species of the genus. Skull and dentition apparently smaller, and crowns of molars differing from those of *minor*.

Distribution.—The holotype, in the British Museum, was part of a small collection obtained from Mr. Beazley, then Museum Taxidermist in Adelaide. Though it was unfortunately unlocalised, Thomas stated that "other specimens in the collection belong either to North Australian species or to such as may have been obtained in the neighbourhood of Adelaide itself." As demonstrated in this paper, the small race *lagotis sagitta*, and *minor*, probably have a much larger range in south central Australia than

External and cranial dimensions of species and subspecies of the genus *Macrotis*.

	<i>M. leucura</i> .	<i>M. minor</i> .		<i>M. l. lagotis</i> .		<i>M. l. interjecta</i> .		<i>M. l. nigripes</i> .		<i>M. l. sagittia</i> .	<i>M. l. grandis</i> .	<i>M. l. cambrica</i> .
	Holotype ♂ (in spirit), very young Central Austr.	min. max. 200 240	♂ min. max. 245 270	ad ♀ ad. ♂	Gracefield, West Australia	Rawlinna, Trans- Austr. Railway, West Australia	Pte ♂ Hltpe ♂	Oodlea Soak, Trans-Riway, Sth. Australia	Killalpaninna, E. of Lake Eyre, Sth. Australia.	Nalpa Lake, Alexandrina Distr., South of Adelaide, Hltpe ♂. st.	New South Wales External dimensions of types; full series crania.	
Head and body ...	142	♀ min. max. 200 240	♂ min. max. 245 270	ad ♀ ad. ♂	Gracefield, West Australia	Rawlinna, Trans- Austr. Railway, West Australia	Altlpe. ♀ Hltpe. ♂	303 318	365 390	316	550	390 600
Tail ...	116	118 162	127 160	252 267		207 232	220 200	207 232	220 200	215	260	246 278
Ear ...	63	68 85	87 92	82 85		80 82	97 90	80 82	97 90	79	77	81/88 93/105
Hindfoot ...	55	57 62	65 73	101 108.5		93 98.5	96 98	93 98.5	96 98	91	114	98 104
Skull.				full series, min. max.							Paratype ♂	full series, min. max.
Basal length ...	45		66	87 94.8		77.7	72.5 81	84.8	365 390	76.5	104	81 96
Nasals, length ...	18		32	44.9 47.5		37.8 42.2	33 40	42.2	220 200	40	48	41.4 49
Nasals, gt. breadth	4.5		6.5	6.8 8		6.5 7.5	7 8	7.5	97 90	7.5		6.8 10
Intertemporal ...	10		11	11 13		11.5 13.4	12 13	13.4	90 77	13		12.1 13.4
Palate length ...	27.7		41	59 62.5		52 56.9	48 50	56.9	90 77	50	66	54 64.3
Palate, breadth outside M's ...			17.5	25 30.5		23.6 23.7	20 20	23.7	90 77	20		24.2 33.8
Palatal foramen ...	5.2		7	11 x 17 11 x 18.5		9.4 x 15 10 x 16	10 10	10 x 16	98 96	10 10		9.6 x 16 12 x 19.3
Front of canine— back of M ⁺ ...			28	41 44		34.9 38.7	34.5 37	38.7	98 96	36	44	38.3 44.5
Horizontal length of Pm's ...	3		3	4.2 4.3		3.8 4.1		4.1	90 77			3.8 4.6
Horizontal length of Pm ⁺ ...			3	3.6 3.9		3.3 3.7		3.7	90 77			3.6 4.5
Horizontal length of M's ...	10		12	13 14.2		11.8 13.3	12 13	13.3	98 96	12.5		13 14.7
Transverse width of M's ...				4.8 6.9		4.1 4		4	98 96			4.7 9

supposed, so that it seems highly probable that *leucura* is the most northern representative of the genus. That it inhabits the more sandy central region is supported by the paler coloration, and possibly by the more insectivorous phase of the dentition, noted by Thomas; the body coloration may have been affected by long spirit preservation.

Remarks.—Apparently in conformity with their smaller size, the absence of a naked area back from the rhinarium suggests a similarity of habits and diet in *leucura* and *minor*, in which surface insects, in *leucura* at least, enter more generally than in *lagotis*. The restriction of the black on the tail of *minor* tends to support the affinity, so that it is just possible that additional material may ally the small forms subspecifically, though the comparative length of the tail of *leucura* is decidedly greater, being five-sixths as opposed to about two-thirds of the length of the head and body in *minor*; the bi-coloration of the belly fur and the white-haired sole further distinguish *leucura*.

It seems, however, in spite of the unsatisfactory nature of the unlocalised material, that there can be no doubt of the specific distinction of this small and very striking rabbit-bandicoot.

The molar structure probably confirms this separation in its approximation to that of *Perameles*, which was regarded by Lydekker as an indication that the Rabbit-Bandicoots were probably a specialised offshoot from that genus.

THE TRUE CRABS OF THE CAPRICORN GROUP. QUEENSLAND.

(Class CRUSTACEA, Order DECAPODA BRACHYURA.)

PART 1. XANTHIDAE.

By MELBOURNE WARD, F.Z.S., Honorary Zoologist,
Australian Museum, Sydney.

Introduction.

The true crabs of the Capricorn Group have previously been studied by Grant and McCulloch; McNeill and Ward. The data for the following paper has been gathered during several visits made by the author to this interesting locality. The first visit was in 1926, when ten days were spent on Heron Island. During that period the fauna of the lagoon, beach and beach rock zones formed the subject for study, and as a result a small paper appeared in "The Australian Zoologist" on the Ecology of a Coral Reef. In 1927, Mr. E. F. Pollock organised a party of naturalists and holiday-makers to visit the islands of both the Capricorn and Bunker Groups during the summer breeding season of the sea birds and turtles. In the Bunker Group, Lady Musgrave, Hoskyn and Fairfax Islands were visited, and Heron, One Tree, Wilson and North West Islands in the Capricorn Group. The zones collected on were the same as on the first trip, and a little dredging was indulged in in Lady Musgrave Lagoon. In June, 1929, Mr. William Boardman, of the Australian Museum, and I spent ten days on North West Island, and had our first opportunity of examining the outer edge of the reef flat, which is only exposed at very low tides. This we found supported a fauna of New Caledonian forms.

In December, 1929, Messrs. Hayter and Embury organised a trip to North West Island and, through their kindness, I was able to obtain interesting forms by dredging for several hours each day. The new species which have been collected in this locality are being described and figured and will appear at a later date. The same gentlemen organised two other expeditions—in May, 1930, and May, 1931, on which I had the pleasure of acting as naturalist.

In spite of the fact that in a previous paper I dealt with some of the interesting ecological problems, it has been deemed advisable to briefly reiterate, as well as augment this data.

There are seven zones in all. Commencing from the land and proceeding seawards, the first is the beach above sea level. Here three species of *Ocypoda* are to be found, living in burrows and obtaining their food on the line of flotsam at the tide level.

The portion of the beach covered by the high tide supports the smallest crustacean fauna of the zones, occasional small colonies of *Mycteris* species and *Uca* species occur, though during the high tide there are several nomadic species which search for food. This steep intertidal beach meets the silt or mud-flat zone at a very clearly marked line, the surface of the mud is firm and is inhabited by the burrowing *Macophtalmus* species. Small fragments of dead coral abound and form the shelters of *Thalamita integra*. The free swimming *Achelous* species moves rapidly about in search of prey and *Calappa hepatica* occurs commonly.

Masses of living coral appear on the mud-flat at some distance from the island, these become more and more numerous until they form great

patches between which narrow aisles of white sand wind their tortuous ways. These passages finally end at the rampart or reef-crest zone, which is a belt of dead coral extending along the reef separating the lagoon from the New Caledonian zone; the characteristic niggerheads extend along the higher part of the crest and shelter wanderers from the outer New Caledonian zone. This is the actual edge of the reef, and is only exposed at spring tides. There is a substratum of coral rock over which a carpet of living corals is spread, these corals are very flat, owing to the rush of the surf, and the few inches of water with which they are covered at the spring low tides.

This water is the overflow from the lagoon, which cascades out to the surrounding sea. In some parts of the zone the superficial layer or carpet of coral forms a perfect covering over the substratum; in others the coral rock is free of such covering and is encrusted with *Lithothamnion* which is also present on dead portions of all the coral zones. In the parts where the live corals are not so numerous the surface of the reef presents a succession of basin pools, each on a lower plane, so that the water overflows from one to the other. After leaving the Crest the sides of the pools met with are coated with algae and have occasional masses of living corals. None of the basin pools is very deep, two feet on an average; the floors of the pools are covered with white sand. There is another type of pool in the zone which occurs very near the edge of the reef, these are deeper, some are several fathoms in depth and the sides or walls are made up of masses of corals superimposed.

In collecting on this area one finds it an easy matter to prise up the superficial layer, large fragments being turned over. At the extreme edge of the reef the underlying surface or substratum presents the entrances to labyrinths down which the denizens disappear quickly. Here are to be found *Cyclax suborbicularis*, *Xanthias punctatus*, *Neoliomera insularis*, and *Carpilius maculatus*.

Where the superficial layer is on a substratum which has collected an inch or two of sand, deposited by the receding tides, *Paraxanthias notatus* is the outstanding species.

In the basin pools are, as previously remarked, masses of live coral which lie upon the sloping sides of the pool; the larger specimens of *Atergatis dilatatus* find refuge under such masses.

The Conglomerate zone assists greatly in the formation of the islands. The rocks are formed entirely of coral sand, and the whole zone is a flat layer crossed and recrossed by cracks and crevices. The fauna bears considerable resemblance to a mainland reef, *Leptodius*, *Grapsus* and *Ozius* are characteristic genera.

As is to be expected, the inhabitants of one zone overlap those of an adjoining zone, but nevertheless the general facies of, for instance the New Caledonian zone, differs markedly from that of the Lagoon zone. *Eriphia sebana* occurs both on the Rampart or Crest and the Conglomerate zone near the island, but not in the lagoon.

The crabs of the family XANTHIDAE form the greater part of the collections, under consideration, and have been dealt with, not in the usual order of classification, but rather on account of the large number of species included. It is my intention to deal with the PORTUNIDAE, GONOPACIDAE, GRAPSIDAE, OCYPODIDAE, OXYSTOMATA and DROMIIDAE in a later paper.

Family XANTHIDAE.

Genus CARPILIUS.

- Carpilius* Leach, in Desmarest, Dict. Sci. Nat., Vol. 28, 1823, 228. Type: *C. maculatus* = *Cancer maculatus*, Linn. 1758. Habitat in Asia.
Carpilius Leach, Rathbun. Bull., 152, U.S. Nat. Mus., Washington, 1930, 239.

CARPILIUS MACULATUS.

- Cancer maculatus* Linnaeus, Syst. Nat., xii., edit. 1, pt. 2, 1767, 1042.
Carpilius maculatus (Linn.) Alcock, Journ. Asiat. Soc. Bengal (n. ser.), lxvii., 2, No. 1, 1898, 79. *Idem.* McCulloch and McNeill, Rec. Austr. Mus., xiv., 1, 1923, 54. *Idem.* McNeill, Aust. Zool., iv., pt. v., 1926, 312.

Since it has been possible to examine the New Caledonian zone it has been found that this apparently rare species is really not uncommon under the superficial layer of living coral.

Material.—One female, 64.5 mm. total carapace width. North West Island, May, 1930.

CARPILIUS CONVEXUS.

- Cancer convexus* Forskal, Desc. Anim., 88.
Cancer adaspersus Herbst Krabben, I., ii., 244, pl. xxi., fig. 1, 1790.
Cancer marmarinus Herbst Krabben, III., iv., 7, pl. lx., fig. 1, 1804.
Carpilius convexus Ruppell, 24 Krabben roth., Meeres, 1830, 13, pl. iii., fig. 2 and pl. vi., fig. 6.
Carpilius convexus Alcock, Journ. Asiat. Soc. Bengal., lxvii., 2, 1898, 80.

This is the largest species inhabiting the masses of corals in the outer lagoon zone, each crab is usually found in compartments formed by the stems of corals.

Material.—One male, measuring 17 mm.* Lady Musgrave Island, November, 1927. Two females, 20 mm. and 21 mm. Heron Island, September, 1926. One female, 41 mm. Hoskyn Island, November, 1927. One female, 79 mm. Heron Island, November, 1927.

Genus CARPILODES.

- Carpilodes* Dana, Amer. Journ. Sci. (2), vol. xii., 1851, 126. Monotypic type *C. tristis* (specific name not given until 1852).
Carpilodes Dana, Rathbun. Bull., 152, U.S. Nat. Mus., Washington, 1930, 241.

CARPILODES SERRATIPES.

- Carpilodes serratipes* Odhner, K. Vet. O. Vitterh. Samh. Handlingar, 1925, 29, 1, 19, pl. 1, fig. 15. Holothuria bank, N.W. Australia.

This small species is interesting on account of not having been collected since Odhner's record; also it has not appeared before on the eastern Australian coast line. During the short visit to the British Museum, London, the author had the pleasure of handling the type of the species and was able to compare the Queensland specimen with it.

The dorsal surface of the carapace of fresh specimen is white; legs and sternal surfaces purple.

Material.—One female, 8 mm. Dredged in 8-10 fathoms off North West Island, May, 1930.

* Note.—In this paper the measurement given is that of the total width of the carapace.

CARPILODES TRISTIS.

Carpilodes tristis Dana, U.S. Explor. Exped., xiii., Crust. I., 1852, 193, Atlas, 1855, pl. 9, fig. 7a-d., Paumotu Arch.? *Idem.* Odhner, K. Vet. O. Vitterh. Samh. Handlingar, 29, I., 1925, 12, pl. 1 fig. 1.

This *Carpilodes* inhabits the under surfaces of coral masses in the lagoon zone.

Material.—Two females, 14 and 23 mm. Fairfax Island, November, 1927. Two males, 11 and 10 mm. Heron Island, November, 1927.

CARPILODES BELLUS.

Actaeodes bellus Dana, U.S. Explor. Exped., xiii., Crust. I., 1852, 196. Atlas, 1855, pl. ii., fig. 2. Samoa, Wakes Island and Paumotu.

Carpilodes vaillantianus A. Milne Edwards. Nouv. Arch. Mus. Hist. Nat. Paris, i., 1865, 231, pl. xi., figs. 3, 3a, 3b. Red Sea. "Isles Maurice et Bourbon," Samoa.

Carpilodes bellus Odhner, K. Vet. O. Vitterh. Samh. Handlingar, 1925, 29, 1, 16, pl. 1., fig. 9. Africa, Indian Ocean. East Indies with East Australia, Mid-Pacific and Hawaiian Islands.

This species, *fide* Odhner, has a very wide distribution throughout the Indo-Pacific and African Coast, but has not been previously recorded from the southern end of the Barrier Reef.

Material.—Two males, 8 and 9 mm.; two females, 9 mm. Heron Island, November, 1927.

CARPILODES CINCTIMANUS.

Carpilius cinctimanus Adams and White, H.M.S. Samarang, Crust. II., 1849, 37, pl. vii., fig. 5. Philippines.

Carpilodes cinctimanus Odhner, K. Vet. O. Vitterh. Samh. Handlingar, 29, 1, 1925, 14. Gulf of Aden to Tahiti.

This is the commonest species of the genus occurring on the Capricorn reefs; it inhabits the outer New Caledonian zone, where it shelters under the living coral. It wanders up on to the crest of the reef, but is by no means common under the niggerheads.

The variation in colour seems to be associated with the growth of the individual, the smallest in the present series, a male 11 mm. in carapace width, has a white carapace and pink legs. The larger forms show the gradual spreading of the red colouring from the gastric towards the branchial areas; in the largest of the series the white entirely disappears and the red deepens; the distal parts of the ambulatory legs are white, the tip of the dactyl brown. Fingers of the chelipeds brown with light tips. The broad dark band on the manus is only developed in the male from Hoskyn Island.

Material.—One female, 35 mm.; one male, 10 mm. Heron Island, November, 1927. One male, 22 mm. Hoskyn Island, November, 1927.

CARPILODES MONTICULOSUS.

Carpilodes monticulosus A. Milne Edwards, Nouv. Arch. Mus. Hist. Nat. Paris, ix., 1873, 181, pl. v., fig. 1. New Caledonia. *Idem.* Odhner, K. Vet. O. Vitterh. Samh. Handlingar, 29, I., 1925, 21, pl. 1., fig. 18. Africa (Natal) to Paumotu.

This species occurs under coral on the New Caledonian zone. It is a prettily marked species, the carapace is white with a few scattered splashes

of pink, the legs are pink, fingers of the chelipeds are pale brown with white tips.

Material.—One female, 9.5 mm. January, 1930, North West Island.

CARPILODES RUGATUS.

Carpilodes rugatus Milne Edwards, Nouv. Arch. Mus. Hist. Nat. Paris, I., 1865, 230, pl. xii, figs. 3, 3a, 3b. Indian Ocean; Coast of China.

Carpilodes rugatus (Milne Edwards) Odhner, K. Vet. O. Vitterh. Samh. Handlingar, 29, 1, 1925, 20, pl. 1, fig. 16. Daedalus shoal, Red Sea to Honolulu, Hawaii.

The species inhabits the caverns in the New Caledonian zone.

Carapace and legs uniform dark plum, varying through a series, some specimens being slightly lighter than others. Dactyles of the ambulatory legs tipped with white. In the lighter individuals the fingers of the hand are red at the base with tips white; in the darker forms the red is replaced by brown and the tips are white.

Material.—Two males, 13 and 15.5 mm. Four females, from 10 mm. to 15 mm. Collected in May, 1930.

Genus NEOLIOMERA.

Neoliomera Odhner, K. Vet. O. Vitterh. Samh. Handlingar, Bd., 29, No. 1. 1925, 25. Type, *N. insularis* (Adams & White), Philippines.

NEOLIOMERA INSULARIS.

Atergatis insularis Adams and White, Zool. Samarang, iv., Crust. II., 1849, 38, pl. viii, fig. 2. Philippines.

Neoliomera insularis (White) Odhner, K. Vet. O. Vitterh. Samh. Handlingar, Bd., 29, I., 1925, 32, pl. ii, fig. 14. New Guinea, Santa Cruz. Samboanga, Mindanao, Bonin Islands, Port Lloyd.

Atergatis Montrouzieri A. Milne Edwards, Nouv. Archiv. Mus. Hist. Nat. Paris, ix., 1873, 186, pl. v., fig. 5. New Caledonia.

The species is apparently rare on the Australian reefs. The present series was obtained on the New Caledonian zone, where it inhabited the under surfaces of the superficial layer of living coral.

All four specimens are uniform light red, the smaller males are paler than the large female.

Material.—Three males, 7, 11, and 15 mm. North West Island, June, 1929. One female, 40 mm. North West Island, June, 1929 (retained in Ward Coll.).

Genus ATERGATIS.

Atergatis de Haan, in Siebold Fauna Japon., Crust., 1833, 17. Type, *A. integerrimus* de Haan, Japan.

Atergatis de Haan, Alcock Journ. Asiat. Soc. Bengal, lxii, pt. 11, No. 1, 1898, 94.

ATERGATIS OCYROE.

Cancer ocyroe Herbst, Naturg. d. Krabben u. Krebse, III., 2, 1801, 20, pl. liv., fig. 2. East Indies.

Atergatis ocyroe (Herbst) McNeill and Ward, Rec. Aust. Mus. Sydney, xvii., 9, 1930, 382. New South Wales.

This is an abundant species on the coral reefs and on the mainland rocky reefs. It is a form not directly associated with living coral.

Material.—One female, 46 mm.; one male, 36 mm. Heron Island, September, 1926. Two males, 42 and 53 mm. Lady Musgrave Island, November, 1927. One female, 24 mm. Hoskyn Island, November, 1927.

ATERGATIS DILATATUS.

Atergatis dilatatus de Haan, Siebolds Fauna Japon., Crust., 1835, 46, pl. xiv., fig. 2. Japan. *Idem.* A. Milne Edwards, Nouv. Archiv. Mus. Hist. Nat. Paris, I., 1865, 238, and Nouv. Archiv. Mus. Hist. Nat. Paris, ix., 1873, 183, pl. v., fig. 6. New Caledonia. *Idem.* Alcock, Journ. Asiat. Soc. Bangal, lxvii., II., 1, 1898, 96. Ceylon; Andamans.

The coloration of this species makes it one of the most beautiful of the reef forms. The carapace is orange yellow in the central portions; white on the margins. The limbs are violet and the fingers of the chelae dark brown. The colours are more brilliant in small, becoming faded in old individuals.

Material.—Four males, 35, 36, 67, and 72 mm.; one female, 50 mm. North West Island, June, 1929.

Genus PLATYPODIA.

Platypodia Bell, Trans. Zool. Soc. London, Vol. 1, 1835, 336. Type, *P. granulosa* (Ruppell). Red Sea.

Platypodia Bell, Rathbun Bull., 152, U.S. Nat. Mus. Washington, 1930, 246.

PLATYPODIA ANAGLYPTA.

Atergatis anaglyptus Heller, Abhandl. zool.-bot. Ges. Wien., 1861, 6, and S.B. Akad. Wien., xliii., 1861, 312, pl. ii., figs. 11, 12. Red Sea.

Lophactaea anaglypta (Heller) A. Milne Edwards, Alcock, Journ. Asiat. Soc. Bengal, lxvii., II., 1, 3, 102. Galle, in Persian Gulf.

The species occurs under nigger heads and in the crannies between living and dead corals.

Material.—Three females, 32, 33 and 32mm. Heron Island, September, 1926. One male, 13 mm.; one female, 14 mm. Fairfax Island, November, 1927.

PLATYPODIA FISSA.

Lophactaea fissa Henderson, Trans. Linn. Soc. London (2), Zool., v., 10, 1893, 355, pl. xxxvi., figs. 8-8a. Tuticorin.

Platypodia fissa (Henderson) Edmondson, Bernice Bishop Mus. Bull., 5. Honolulu, 1923, 13. Palmyra Island.

The first specimens collected of this species were found in masses of living *Tubipora musica* in the outer Lagoon zone, but later others have been obtained under the layer of living corals on the New Caledonian zone.

Material.—Two females, 15 and 25 mm.; one male, 27 mm. North West Island, December, 1929.

PLATYPODIA SEMIGRANOSA.

Atergatis semigranosus Heller, Sitzungsber. Kais. Akad. Wiss. Wien., Bd., 43, 1861, 313. Red Sea.

Lophactaea semigranosa (Heller) de Man, Abh. Senckenb. naturf. Ges., xxv., 1903, 582, pl. xxi., fig. 19. Batjan. and synonymy.

Material.—One male, 10 mm. North West Island, December, 1929.

PLATYPODIA GRANULOSA.

Xantho granulatus Ruppell, 24 Krabben roth. Meeres, 1830, 24, pl. v., fig. 3. Red Sea.

Lophactaea granulosa (Ruppell) Alcock, Journ. Asiat. Soc. Bengal, lxvii., II., 1, 1898, 101. Australia and Samoa.

Material.—Eight males, from 13 to 41 mm.; five females, 14, 15, 19 and 36 mm. Heron Island, September, 1926. Four females, 16 to 40 mm. Heron Island, September, 1926. One male, 18 mm. North West Island, November, 1927. One male, 30 mm. Fairfax Island, November, 1927.

Genus ZOZYMUS.

Zozymus Leach (Dict. Sci. Nat., xii., 75, Miers), and in Desmarest Consid. Gen. Crust., 1825, 105. (Footnote). *Z. aeneus* (Linn.) (In India, Linn.).

Zozymus Leach, Alcock, Journ. Asiat. Soc. Bengal, lxvii., pt. II., No. 1, 1898, 103.

ZOZYMUS AENEUS.

Zozymus aeneus (Linn.) Alcock, Journ. Asiat. Soc. Bengal, lxvii., pt. ii., No. 1, 1898, 104. Andamans and Laccadives.

The species is abundant on the reef at One Tree Island, where it occurs under the masses of dead corals, nigger heads, which are numerous on the reef crest. On the other reefs it is not so numerous.

An interesting association is to be observed in the appearance of the Rhizocephalid genus *Thomsonia* upon the sternal surface and walking legs of certain individuals.

Materials.—Nine males, from 33 to 85 mm.; six females, 49 to 76 mm. One Tree Island, November, 1927. One male, 25 mm. North West Island, November, 1927. One male, 25 mm. Hoskyn Island, November, 1927. Two females, 47 and 42 mm. Heron Island, September, 1926.

Genus LOPHOZOZYMUS.

Lophozozymus A. Milne Edwards, Ann. Sci. Nat. Zool. (4), xx., 1863, 276.

Type, *Lophozozymus incisus* (H. Milne Edwards), Australasia.

LOPHOZOZYMUS PICTOR.

Cancer pictor Fabricius, Entom. Syst. Suppl., 1793, 335.

Lophozozymus pictor Rathbun, Archiv. fur. zool. Bd., 16, 23, 1924, 15. Singapore and Malay Arch. to Japan, and N.W., N.E. and Central Australia; Fiji and Samoa.

Lophozozymus octodentatus Ward, Aust. Zoologist, Vol. v., Pt. iii., 1928, pl. xxix. Capricorn Group, Queensland.

This species is more numerous on the mainland reefs than on the Capricorns.

EUXANTHUS.

Euxanthus Dana, Sillimans Amer. Journ. Sci. and Art. (2), xii., 1851, 125; Proc. Ac. Nat. Sci. Philad., 1852, 75; and U.S. Explor. Exped., xiii., Crust., pt. 1, 1852, 173. Type, *Euxanthus sculptilis* Dana. Fiji or Tongatabu.

EUXANTHUS MELISSA.

Cancer melissa Herbst, Krabben., III., ii., 1801, 7, pl. li., fig. 1. Habitat unknown.

Euxanthus melissa (Herbst) Alcock, Journ. Asiat. Soc. Bengal, lxvii., II., i., 1898, 110. Andamans; Mergui and Ceylon.

The species occurs under living coral on the New Caledonian zone; occasional specimens are obtained in the Lagoon zone under the live corals.

Material.—Three females, from 41 to 66 mm. North West Island, December, 1929, January, 1930.

Genus XANTHO.

Xantho Leach, Malac. Pod. Britt., 1815, pl. xi., and text, and Trans. Linn. Soc. London, xi., 1815, 320. Devon, England. Type = *Cancer floridus* Montagu, Trans. Linn. Soc., ix., 85, pl. ii., fig. 1.

XANTHO DEMANI.

Xantho subacutus (Stimpson) de Mau, Abh. Senckenb. Nat. Ges., Frankfurt, Bd., 25, 1902, 595.

Xantho demani Odhner, K. Vet. O. Vitterh. Samh. Handlingar, Bd., 29, 1924, 1.

The species occurs on the New Caledonian zone under the layer of living coral.

Material.—Four males, 10 to 24 mm.; one female, 20 mm. North West Island, May, 1930.

Genus LEPTODIUS.

Leptodius A. Milne Edwards, Ann. Sci. Nat. (4), xx., 1863, 234. Type, *L. exaratus* (Milne Edwards), Cotes de L'Inde = *Chlorodius exaratus*.

Leptodius A. Milne Edwards, Rathbun. Bull., 152, U.S. Nat. Mus. Washington, 1930, 296.

LEPTODIUS SANGUINEUS.

Chlorodius sanguineus H. Milne Edwards, Hist. Nat. Crust., 1834, I., 402. Ile-de-France.

Xantho (Leptodius) sanguineus (H. Edwards) A. Milne Edwards, Alcock, Journ. Asiat. Soc. Bengal, lxxvii., II., 1, 1898, 3, 1, 119. Andamans and Laccadives, Nicobars, Ceylon and Persian Gulf.

The species occurs commonly under the slabs of conglomerate beach rock on sand; each individual hollows a small compartment in the sand. This is one of the forms which feigns death after the stone under which it is hiding has been removed.

Material.—Six males, from 11 to 28 mm.; six females, 12 to 28 mm. Heron Island, 1926.

LEPTODIUS NUDIPES.

Chlorodius nudipes Dana, Proc. Acad. Nat. Sci. Philadelphia, 1852, 79, and U.S. Explor. Crust., I., 1852, 209, Atlas, 1855, pl. xi., figs. 12a-c. Mangsi Islands.

Xantho (Leptodius) nudipes (Dana), A. Milne Edwards, Alcock, Journ. Asiat. Soc. Bengal, lxxvii., II., 3, 1, 1898, 121. Andamans and Mergui.

The species occurs under the slabs of dead coral in the Lagoon zone.

Material.—One male, 12 mm. (specimen compared with specimens in Paris Museum). North West Island, July, 1929.

Genus CYCLOXANTHOPS.

Cycloxanthops Rathbun. Bull., 152, U.S. Nat. Mus. Washington, 1930, 289. Type, *C. serdecimdentatus* (Milne Edwards and Lucas). Mexico?

CYCLOXANTHOPS CAVATA.

Cycloxanthops cavata Rathbun, Mem. Mus. Camp. Zool. Cambridge, xxxv., 2, 1907, 41, pl. v., fig. 8. Paumotu.

This is one of the interesting species of the New Caledonian zone, where it occurs under the layer of coral in situations where an amount of sand has been caught, the crabs burying themselves when the protecting coral

is lifted. The colour is usually white, some have the carapace and legs speckled with dark brown, two of the females have a red blotch on the carapace just behind the front.

A specimen of the original series in the National Museum, Washington, was examined, and the Australian series compared with it.

Material.—Four males, 5-7 mm. North West Island, June, 1929. Six females, 5-9 mm. North West Island, December, 1929.

Genus ETISUS.

Etisus H. Milne Edwards, Hist. Nat. Crust., I., 1834, 410. Type, *E. dentatus* (Herbst) = *Cancer dentatus* Herbst.

Etisodes Dana, sub-genus of *Etisus*.

Etisodes Dana, Sillimans Amer. Journ. Sci. and Arts (2), xii., 126 (foot-note); Proc. Acad. Nat. Sci. Philad., 1852, 77; and U.S. Explor. Exped., xiii., I., 1852, 185, 184. Type, *E. frontalis* Dana. Sooloo Sea.

Etisus (*Etisodes*) Klunzinger, Nova Acta der Leop. = Carol. Akad., Bd., 99. Halle, 1913, 234. Odhner, K. Vet. O. Vitterh. = Samh. Handlingar, Bd., 29, No. 1, 1924, 83.

ETISUS LAEVIMANUS.

Etisus laevimanus Randall, Journ. Acad. Nat. Sci. Philad., 1839, 115. *Idem*. Alcock, Journ. Asiat. Soc. Bengal, lxvii., ii., i., 1898, 131. Persian Gulf; Karachi; Bombay; Laccadives; Andamans; Singapore. *Idem*. Klunzinger, Nova. Acta. Abh. du Kaiserl. Leop.-Carol. Deutschen. Alsademie der Naturforschen, Bd., 1c., No. 2, 1913, 237, pl. vi., figs. 13a-b. Red Sea. *Idem*. Odhner, K. Vet. O. Vitterh. Samh. Handlingar, Bd., 29, No. 1, 1925, 83.

Material.—Two males, 47 and 55 mm.; four females, from 36 to 52 mm. Heron Island, 1926. One male. North West Island, 1926.

ETISUS (ETISODES) ANAGLYPTUS.

Etisus anaglyptus H. Milne Edwards, Hist. Nat. Crust., 1834, 411. Australia.

Cancer anaglyptus H. M. Edwards, in Cuvier, Regne Anim. Crust., 1836, pt. xi., fig. 4.

Etisodes anaglyptus Lanchester, Proc. Zool. Soc., 1900, 739, pl. xlv., fig. 5. Samoa; Australia; Philippines; Timor; Flores; Pulan Setang; Singapore; Persian Gulf. *Idem*. de Man, Abh. Senckenb. Ges., xxv., iii., 1902, 605.

Etisus (*Etisodes*) *anaglyptus* Odhner, K. Vet. O. Vitterh. Samh. Handlingar.

Material.—One female, 45 mm. Heron Island.

ETISUS (ETISODES) ELECTRA.

Cancer electra Herbst, Krabben., iii., ii., 1801, 34 and 36, pl. li., fig. 6, and pl. liv., fig. 3.

Etisodes electra Alcock, Journ. Asiat. Soc. Bengal, lxvii., pt. ii., No. 1, 1898.

Etisodes electra (Herbst) Calman, Trans. Linn. Soc. London (2), Zool., viii., I., 1900, 7.

Etisus (*Etisodes*) *electra* Odhner, K. Vet. O. Vitterh. Samh. Handlingar., Bd., 29, No. 1, 1925, 83.

The species is common under blocks of coral in the lagoon.

Material.—One female, 19 mm. North West Island. Two females, 11, 16 mm. Heron Island. Two females, 14, 16 mm. Lady Musgrave Island. Nine females, 13 to 17 mm.; five males, 14 to 17 mm. Heron Island, 1926.

Genus ACTAEA.

Actaea de Haan, in Siebold, Fauna Japon. Crust., 1833, 4 and 18. Type, *A. savignii* (Milne Edwards). = *Cancer savignii* Milne Edwards, 1834. Red Sea and the Indian Ocean. = *Cancer granulatus* Audouin, 1825, not *C. granulatus* Linn., 1758, America.

Actaea de Haan, Rathbun. Bull., 152, U.S. Nat. Mus. Washington, 1930, 250.

ACTAEA ACIES.

Actaea acies Rathbun, Trans. Linn. Soc. London (2), Zool., xiv., II., 1911, 219, pl. xvi., figs. 8-9. Saya de Malta; Salomon, Egmont Lagoon.

The species occurs in holes in the living masses of *Tubipora musica* in the lagoon zone.

Material.—Two females, 17 and 18 mm. Heron Island, September, 1926.

ACTAEA BANARIAS.

Actaea banarias Rathbun, Trans. Linn. Soc. London (2), Zool., xiv., II., 1911, 223, pl. 18, figs. 7 and 8. Salmon, Egmont Reef lagoon.

The species is common in the passages and crannies of the living *Tubipora musica* in the lagoon zone.

Material.—Two males, 9-10 mm.; 11 females, from 9-12 mm. North West Island, November, 1927. One female, 10 mm.; one male, 10 mm. Heron Island, November, 1927. One male, 7 mm. Heron Island, September, 1926.

ACTAEA CAVIPES.

Actaeodes cavipes Dana, Proc. Acad. Nat. Sci. Philad., 1852, 78, and U.S. Explor. Exped., xiii., Crust. I., 1852, 199. Atlas, 1855, pl. xi., figs. 5a-b. Fiji, Samoa.

Actaea cellulosa Dana, U.S. Explor. Exped., xiii., Crust. I., 1852, 164. Atlas, 1855, pl. viii., fig. 2. Tutuila, Samoa.

Actaea schmardae Heller, Beitr. z. Crust. Fauna d. Rothen. Meeres, in S.B. Akad. Wien., Bd., 43, I., 1861, 318, pl. 1., fig. 13. Red Sea.

Glyptoxanthus cymbifer Rathbun, Proc. Zool. Soc. London, 1914, 658, pl. 1., 11, figs. 6, 7. Monte Bello Islands.

The species inhabits the deep crannies in dead or partly dead corals in the lagoon zone.

Material.—Two females, 13-15 mm.; one male, 10 mm. Lady Musgrave Island, November, 1927. One female, 15 mm.; one male, 13 mm. Heron Island, November, 1927. Four females, 10 to 13 mm.; two males, 9 and 11 mm. Heron Island, September, 1926.

ACTAEA CONSOBRINA.

Actaea consobrina A. Milne Edwards, Journ. Mus. Godeffroy, Heft. 4, Hamburg, 1873, 79. Upolu, Samoa.

Actaea suffuscula Rathbun, Trans. Linn. Soc. London (2), Zool., xiv., II., 1911, 220, pl. 17, figs. 10 and 11. Salmon; Cotivry.

Actaea consobrina A. Milne Edwards, Odhner, K. Vet. O. Vitterh. Samh. Handlingar, Bd., 29, 1, 1924, 67, pl. iv., fig. 14. Bonin-Marshall, Gilbert, Ellice, Samoa, Marquesas Islands.

Rathbun, loc. cit., remarks the light brown of the fingers extending over the palm; this occurs in both males in the present series; the female, however, has only the fingers brown.

Material.—Two males, 6-9 mm.; one female, 8 mm. North West Island, May, 1930.

ACTAEA POLYACANTHA.

Chlorodius polyacantha Heller, S.B. math. naturw. Cl. Akad. Wiss. Wien., xliii., I., 1861, 339, pl. iii., fig. 21. Red Sea.

Actaea polyacantha (Heller) Rathbun, Trans. Linn. Soc. London, xlv., II., 1911, 222. Coetivy.

The species occurs under the living coral on the New Caledonian zone.

Material.—Two males, 7.5 mm.; two females, 7.5 mm. and 11.5 mm. North West Island, December, 1929.

ACTAEA RUFOPUNCTATA.

Xantho rufopunctatus Milne Edwards, Hist. Nat. Crust. I., 1834, 389. Ile de France.

Actaea nodosa Stimpson, Ann. Lyc. Nat. Hist. New York, 1860, vii., II., 203 (fide Odhner).

Actaea garetti Rathbun, Bull. U.S. Fish. Comm., 1903, III., 852, pl. ix., fig. 8. Hawaiian Islands, Kingsmill Islands, Society Islands, Mauritius (fide Odhner).

Actaea rufopunctata (Milne Edwards), Odhner, K. Vet. O. Vitterh. Samh. Handlingar, Bd., 29, I., 1925, 60. Red Sea; Gulf of Aden; East Coast of Africa; Mombasa; Matamoras; Madagascar; Mauritius; Singapore; East Celebes; Timor; Moluccas; New Guinea; Marshall Island; Gilbert Islands; Fiji Islands; Samoa; Tahiti (fide Odhner).

This is one of the rarer species of the New Caledonian zone, where it is found under the superficial layer of living coral.

Material.—One male, 11 mm. North West Island, December, 1929. One male and one female, 12 mm. and 21 mm. Heron Island, September, 1926.

ACTAEA SPECIOSA.

Actaeodes speciosus Dana, U.S. Explor. Exped. Crust. I., 1852, 198, pl. xi., fig. 4. Samoa.

Actaea speciosa (Dana) Ortmann, Alcock, Journ. Asiat. Soc. Bengal, lxvii., II., 1, 1898, 143. Persian Gulf, Ceylon and Andamans.

The single specimen, a female measuring 3 mm. total carapace width, was collected from the cavity in the base of a small mass of live coral on the New Caledonian zone. June, 1929.

ACTAEA TOMENTOSA.

Zozymus tomentosus H. Milne Edwards, Hist. Nat. Crust. I., 1834, 385. Indian Ocean and in Couvier Regne Anim. Crust., 1836, pl. xi., bis., fig. 2.

Actaea tomentosa Alcock, Journ. Asiat. Soc. Bengal, lxvii., II., 1, 140. *Idem.* Rathbun, Mem. Mus. Comp. Zool. Harvard. Coll., xxxv., 42. Nicobars, Andamans, Palk Str. and Laccadives, Mauritius, Australia and South Seas.

This is a very common reef species, and one which has a wide range in the Indo-Pacific, and occurs upon the east Australian coast as far south as Port Jackson, N.S.W.

Material.—Two males, 13 and 14 mm.; one female, 20 mm. Lady Musgrave Island, November, 1927. Three males, 15 to 34 mm.; two females, 20 and 24 mm. Heron Island, September, 1926.

Genus PARAXANTHIAS.

Paraxanthias Odhner, K. Vet. O. Vitterh. = Samh. Handlingar, Bd., 29, No. 1, 1925, 85. Type, *P. notatus* (Dana). Paumotu and Sandwich Islands.

PARAXANTHIAS NOTATUS.

Xanthodes notatus Dana, U.S. Explor. Exped. Crust., xiii., I., 1852, 18, 8, fig. 12, 1855. Paumotu and Sandwich Islands.

Paraxanthias notatus Odhner, K. Vet. O. Vitterh. Samh. Handlingar, Bd., 29, I., 1925, 85.

Material.—One female, 19 mm. North West Island, November, 1927. One male, 17 mm. Lady Musgrave Island, November, 1927. Three males, 15, 16, 18 mm. One Tree Island, November, 1927. Two females, both 15 mm. One Tree Island, November, 1927. Six males, from 14 to 20 mm.; one female, 19 mm. Heron Island, September, 1926.

PARAXANTHIAS PACHYDACTYLUS.

Xanthodes pachydactylus A. Milne Edwards, Ann. de la Soc. Entomol. France, vii., 1867, 268, and Nouv. Archiv. Mus. Hist. Nat. Paris, ix., 1873, 201, pl. vi., fig. 4. New Caledonia.

Paraxanthias pachydactylus A. M. Edwards, Odhner, K. Vet. O. Vitterh. = Samh. Handlingar, Bd., 29, No. 1, 1924, 84.

Material.—Five males, from 8 mm. to 15.5 mm.; one female, 15 mm. North West Island, December, 1929, January, 1930.

Genus XANTHIAS.

Xanthias Rathbun, Bull. 152, U.S. Nat. Mus. Washington, 1930, 464. Type, *Xanthias lamarckii* (Milne Edwards, 1834). Ile de France = *Xantho granosomanus* Dana, 1852.

XANTHIAS PUNCTATUS.

Xantho punctatus H. Milne Edwards, Hist. Nat. Crust. I., 1834, 396. Mauritius. *Idem*. A. Milne Edwards, Nouv. Archiv. Mus. Hist. Nat. Paris, ix., 1873, 199, pl. vii., fig. 6. New Caledonia.

Liozantho punctatus (Milne Edwards) Alcock, Journ. Asiat. Soc. Bengal, lxvii., II., 1, 1888, 91. Ceylon, Mauritius and Samoa.

Xanthias punctatus (Milne Edwards), Odhner, K. Vet. O. Vitterh. Samh. Hand. Bd., 29, 1, 84, 1924.

Odhner, loc. cit., gives a very interesting note on the species of the genus *Xanthias* and *Liozanthus*, and in the present study I have followed his example.

The species is not uncommon under the superficial layers of live corals on the New Caledonian zone.

The coloration is very beautiful and characteristic, specimens examined in continental museums display similar markings.

The posterior regions of the carapace are dotted with red brown; the mid-gastric area is clouded with brown; the hepatic and anterior branchial regions are also clouded with brown.

Material.—Four males, 11, 16, 26, 31 mm.; three females, 16, 34, 36 mm. North West Island, January, 1930.

XANTHIAS LAMARCKII.

Xantho lamarckii Milne Edwards, Hist. Nat. Crust. I., 1834, 391. Ile de France.

Xanthodes lamarckii Milne Edwards, Alcock, Journ. Asiat. Soc. Bengal, lxvii., II., 1, 1898, 157. Andamans; Madras Coast and Ceylon.

The species occurs under nigger heads, but is most abundant on the New Caledonian zone, where individuals are found sheltering under the layer of living corals.

Material.—One female, 11 mm.; three males, 17 to 22 mm. Heron Island, November, 1927. Two females, 20 and 22 mm. One Tree Island, November, 1927. Two females, 14 and 16 mm.; one male, 18 mm. North West Island, November, 1927. One male, 17 mm. Lady Musgrave Island, November, 1927. One male, 17 mm.; one female, 16 mm. Hoskyn Island, November, 1927. One female, 20 mm. Heron Island, September, 1926.

NEOXANTHIAS gen. nov.

Type, *Neoxanthias impressus* (Lamarck) = *Xantho impressus* (Lamarck) Milne Edwards, Alcock. Ile de France.

NEOXANTHIAS IMPRESSUS.

Cancer impressus Lamarck, Hist. Nat. Anim. Sans. Vert., v., 1818, 272. Isle de France.

Xantho impressus (Lamarck) H. Milne Edwards, Hist. Nat. Crust., I., 1834, 393. Isle de France. *Idem.* Alcock, Journ. Asiat. Soc. Bengal, lxvii., 11, 1, 1898, 115. Mergui; Andamans; Mauritius.

The type species, *Xantho floridus* of European seas, has been examined and compared with specimens of *Neoxanthias impressus*, and found to differ markedly in the dimensions of the carapace, in the shape of the chelipeds and the shape of the merus of the external maxillipeds. *Xantho floridus* approaches *Leptodius* rather than *Neoxanthias*, which in turn resembles *Xanthias* in the chelae, being equal in size, but differs from the type species *Xanthias lamarcki* in having the first lobe of the antero-lateral margins produced beyond the orbit, and in having the carapace deeply areolate. The male copulatory appendages resemble those of *Xanthias*, but are less hooked at the tips.

Eudora de Haan, 1834? is preoccupied by *Eudora* Peron and Lesueur, Ann. Mus. Hist. Nat. Paris, xiv. (83), 1810, 326. Med.

The species is one of the rarities of the Queensland reefs and inhabits the New Caledonian zone, where it shelters under the layer of living coral.

Material.—One female, 57 mm. North West Island, December, 1929, January, 1930.

Genus *CHLORODIELLA*.

Chlorodiella Rathbun, Proc. Biol. Soc. Washington, Vol. 11, 1897, 157, and Bull. 52, U.S. Nat. Mus. Washington, 1930, 462. Type, *C. niger* (Forsk.) = *Chlorodius* Milne Edwards, Hist. Nat. Crust., Vol. 1, 1834, 399 and 401, *C. niger* (Forsk.). Red Sea.

CHLORODIELLA NIGRA.

Cancer niger Forskal, Descr. Anim., 1775, 89.

Chlorodius niger (Forsk.) Ruppell, A. M. Edwards, Alcock, Journ. Asiat. Soc. Bengal, lxvii., II., 1, 3, pt. 1, 1898, 160. Andamans, Nicobars, Mergui, and Merkan Coast and Indo-Pacific.

Chlorodiella niger (Forsk.) Rathbun, Bull. U.S. Fish. Comm., 1903, III., 857. Hawaiian Islands.

Material.—Six males, 13 to 28 mm.; 19 females, 9 to 23 mm. Heron Island, 1926. One male, 17 mm. Hoskyn Island. One male, 20 mm. Heron Island. Two males, 13 and 14 mm. One Tree Island. One female, 11 mm. North West Island. Three females, 10 to 12 mm.; six males, 8 to 23 mm. Fairfax Island.

The coloration of this species is uniform dark brown in the adult, but the immature have the carapace mottled with a greenish light brown. As

evidenced by the large series in the collection, this is the common *Xanthid* on the Capricorn reefs, being found in the crannies between the branches of the living and dead corals.

CHLORODIELLA BARBATA.

Chlorodius barbatus Borradaile, Proc. Zool. Soc. London, 1900, 587, pl. xli., fig. 4. Rotuma.

The emphasis placed by the artist on the grooves of the carapace in Borradaile's figure is misleading, for, upon examining specimens from Saloman in the British Museum, Sealark Expedition, and, comparing them with the figure quoted, the grooves prove to be faintly marked, as stated by Borradaile in the text of the quoted paper.

The species occurs commonly amongst *Halimeda* weed, which grows thickly on dead branching coral in the lagoon.

Material.—One male, 9 mm. North West Island, December, 1929.

Genus PHYMIDIUS.

Phymodius A. Milne Edwards, Ann. Sci. Nat. (4), xx., 1863, 283. Type, *P. unguatus* H. M. Edwards. Australasia.

Phymodius A. Milne Edwards, Rathbun, Bull., 152, U.S. Nat. Mus. Washington, 1930, 249.

PHYMIDIUS SCULPTUS.

Chlorodius sculptus A. Milne Edwards, Nouv. Arch. Mus. Hist. Nat. Paris, ix., 1873, 217, pl. viii., fig. 4. New Caledonia.

Phymodius sculptus (A. Milne Edwards) Alcock, Journ. Asiat. Soc. Bengal, lxvii., II., 1898, 164. Andamans, Mergui; Ceylon. *Idem.* Grant and McCulloch, Proc. Linn. Soc. N.S.W., xxxi., 1906, 13. Masthead Island, Capricorn Group.

Material.—One male, 18 mm. One Tree Island, November, 1929.

PHYMIDIUS UNGULATUS.

Chlorodius unguatus H. M. Edwards, Hist. Nat. Crust. I., 1834, 400, pl. 16, figs. 6-8. Australasia.

Phymodius unguatus (Milne Edwards) Alcock, Journ. Asiat. Soc. Bengal, lxvii., II., No. 1, 1898, 162. Andamans, Ceylon.

Phymodius unguatus (Milne Edwards) Rathbun, Mem. Mus. Comp. Zool. Harvard., xxxv., 2, 1907, 46, pl. iii., and iv., No. Mohican Reef; Tahiti; Paumotu; Society Islands; Tongatabu; Ellice Islands; Tari Tari Island; and Carolines. *Idem.* de Man, Abh. Senckenb. Ges., xxv., III., 1902, 618. Ternate.

Material.—Six females, from 18 to 35 mm.; 11 males, from 15 to 35 mm. Heron Island, September, 1926. One male, 33 mm.; two females, 21-31 mm. Hoskyn Island, November, 1927. Two males, 12-25 mm.; five females, 16-17 mm.—One Tree Island, November, 1927. Five males, 12 to 31 mm.; one female, 16 mm. Lady Musgrave Island. One male, 18 mm. North West Island.

Genus CHLORODOPSIS.

Chlorodopsis A. Milne Edwards, Nouv. Archiv. Mus. Hist. Nat. Paris, ix., 1873, 227.

Chlorodopsis Alcock, Journ. Asiat. Soc. Bengal, lxvii., II., No. 1, 1898, 165. Type, *Chlorodopsis melanochirus* A. Milne Edwards. New Caledonia.

CHLORODOPSIS SCABRICULA.

Chlorodopsis scabricula (Dana) Rathbun, Bull. U.S. Fish. Comm., 1908

(1906), III., 859. Hawaiian Islands; and Mem. Mus. Comp. Zool. Harvard, xxxv., II., 1907, 50, pl. 1, fig. 3, pl. ix., fig. 5. Tahiti.

The species occurs amongst living corals, New Caledonian zone.

Material.—Three males, 7, 7 and 7.5 mm. North West Island, December, 1929.

CHLORODOPSIS MELANOCHIRUS.

Chlorodopsis melanochirus A. Milne Edwards, Nouv. Archiv. Mus. Hist. Nat. Paris, ix., 1873, 228, pl. viii., fig. 5. New Caledonia.

Chlorodopsis melanochira A. Milne Edwards, Alcock, Journ. Asiat. Soc. Bengal, lxvii., II., 1898, 168. Andamans.

The species occurs on the under surfaces of nigger heads and masses of corals in the basin pools on the outer reef crest zone.

Material.—Two males, 8 and 11 mm. North West Island, June, 1929.

CHLORODOPSIS SPINIPES.

Pilodius spinipes Heller, S.B. Ak. Wiss., xliii., 340, pl. iii., fig. 22 (1861). Red Sea.

Chlorodopsis spinipes Calman, Trans. Linn. Soc. London (2), Zool., 1900, 12. Murray Island; Red Sea to New Caledonia.

Material.—Three males, 10.5 mm. to 11.5 mm. North West Island, December, 1929.

CHLORODOPSIS MELANODACTYLUS.

Chlorodopsis melanodactylus Milne Edwards, Nouv. Arch. Mus. Hist. Nat. Paris, ix., 1873, 229, pl. viii., fig. 7. New Caledonia.

Chlorodopsis melanodactyla Lenz, Abh. Senckenb. Ges., xxvii., 1905, 355. Zanzibar. *Idem.* de Man, Abh. Senckenb. Ges., xxv., 1902, 624. Ternate. The species is common in the *Lithothamnion* covered dead coral portion of the New Caledonian zone.

Material.—Four males, 12, 13, 14 and 14.5 mm.; two females, 10 and 13 mm. North West Island, December, 1929.

CHLORODOPSIS AREOLATUS.

Chlorodius areolatus H. Milne Edwards, Hist. Nat. Crust. I., 400. New Holland.

Chlorodopsis areolatus Alcock, Journ. Asiat. Soc. Bengal, lxviii., II., 1898, 166. Andamans, Nicobars, Ceylon, Mauritius and South Seas.

Genus CYMO.

Cancer (*Cymo*) de Haan, in Siebold Fauna Japon., 1834?, 22.

Cymo de Haan, Alcock, Journ. Asiat. Soc. Bengal, lxvii., II., No. 1, 1898, 172. Type, *Cymo andreossi* (Audouin) Egypt.

CYMO ANDREOSSI.

Cymo andreossi Stimpson, Smithsonian. Insti. Washington Misc. Coll., 49, 1907, 60. Bonin Islands. *Idem.* Grant and McCulloch, Proc. Linn. Soc. Sydney, xxxii., 152. Masthead Island, Capricorn Group.

The species is found in the branches of the living "Staghorn" coral in the lagoon and New Caledonian zones.

Material.—Four females, from 13 to 15 mm.; two males, 12 and 12 mm. Heron Island, September, 1926. One female, 13 mm. Hoskyn Island, November, 1927. One female, 15 mm. Lady Musgrave Island, November, 1927.

Genus PSEUDOZIUS.

Pseudozius Dana, Sillimans Amer. Journ. Sci. and Art (2), xii., 1851, 127;

Proc. Acad. Nat. Sci. Philad., 1852, 81; and U.S. Explor. Exped., xiii., Crust. I., 1852, 232.

Pseudozius Dana, Klunzinger, Nova. Acta. Abh. d. Kaiserl. Leop.-Carol. Deutsch. Akad. Natur., Bd. IC., nr. 2, 1913, 283. Type, *Pseudozius cays-trus* (Adams and White) "Maria Orientalia" = *P. planus* Dana, Water-land Island, Raraka Island, Paumotu Arch. and Wakes Island, North Pacific.

PSEUDOZIUS DISPAR.

Pseudozius dispar Dana, U.S. Explor. Exped., xiii., Crust. I., 1852, 235, pl. xiii., fig. 9. Sooloo Sea. *Idem.* Calman, Trans. Linn. Soc. (2), Zool., viii., I., 1900, 14, and syn., Murray Island, Torres Strait, New Caledonia, Sooloo Sea.

In certain parts of the lagoon zone there are dead masses of coral covered by a thick growth of algae, which entirely fills the spaces between the coral branches, and it is amongst this weed that *Pseudozius dispar* is found.

Material.—One female, 11 mm. Hoskyn Island, November, 1927. One female, 8 mm. Lady Musgrave Island, November, 1927. Two females, 8 and 11 mm. North West Island, November, 1927. Six females, from 7 to 9 mm.; three males, 7 to 9 mm. Heron Island, September, 1926. One male, 11 mm. Lady Musgrave Island, November, 1927.

Genus PILUMNUS.

Pilumnus Leach, Trans. Linn. Soc. London, II., 1815, 309 and 321. Type, *P. hirtellus*. European?

Pilumnus Leach, Rathbun, Bull., 152, U.S. Nat. Mus. Washington, 1930, 481.

PILUMNUS SLUITERI.

Pilumnus sluiteri de Man, in Weber's Zool. Ergebn. Niederl. Ost.-Ind., II., 1892, 283, pl. I., fig. 2. East Indies. *Idem.* Alcock, Journ. Asiat. Soc. Bengal, lxxvii., II, 1, 1898, 194. Andamans and Samoa. Occurs under living coral on the New Caledonian zone.

Material.—One female, 33 mm. North West Island.

PILUMNUS TERRAE-REGINAE.

Pilumnus terrae-reginae Haswell, Proc. Linn. Soc. N.S.W., vi., 1882, 752. Port Molle, Queensland. *Idem.* Grant and McCulloch, Proc. Linn. Soc. N.S.W., xxxi., 1906, 15, pl. I., figs. 1-1a. Port Curtis, Queensland, Masthead Island, Capricorn Group.

This is one of the few mainland species which ranges out to the coral reef.

Material.—One male, 9 mm. Heron Island. Three females, 8-11 mm. North West Island.

PILUMNUS SPINICARPUS.

Pilumnus spinicarpus Grant and McCulloch, Proc. Linn. Soc. N.S.W., 1906, I, 15, pl. I., figs. 2-2a. Masthead Island.

This is without a doubt the commonest species of *Pilumnus* in the locality. It occurs under the nigger heads. and in the deep crannies of the masses of coral in the lagoon zone.

Material.—One female, 15 mm. Lady Musgrave Island. Four females, from 11 to 17 mm.; one male, 14 mm. Heron Island. One female. Hoskyn Island. Five females, 11 to 16 mm.; five males, 9 to 15 mm. Heron Island, 1926.

PILUMNUS CAERULESCENS.

Pilumnus caeruleus A. Milne Edwards, Nouv. Archiv. Mus. Hist. Nat. Paris, ix., 1873, 242, pl. ix., fig. 3. New Caledonia. *Idem.* McNeill, Aust. Zoologist, iv., 5, 1926, 315. North West Island, Capricorn Group. The species occurs on the New Caledonian zone under the living coral. Material.—Three males, from 9 to 10 mm.; three females, 9 to 10 mm. North West Island. One male, 9 mm. Heron Island, 1926.

PILUMNUS ACTUMNOIDES.

Pilumnus actumnoides A. Milne Edwards, Nouv. Archiv. Mus. Hist. Nat. Paris, ix., 1873, 247, pl. x., fig. 3. New Caledonia.

The occurrence of this species is of great interest owing to the fact that it has not been previously noted on our coast; also that, apart from the original description, it has not been recognised outside the type locality.

It is very common in circumscribed areas on the New Caledonian zone, where it is found under the living corals, and was particularly numerous during the mid-winter trip in 1929. I was unable to find either types or specimens in the Paris Museum.

Material.—Two males, 14 and 17 mm.; one female, 13 mm. North West Island, May, 1930.

Genus ACTUMNUS.

Actumnus Dana, Sillimans Amer. Journ. Sci. and Arts (2), xii., 1851, 128; U.S. Explor. Exped., xiii., Crust. I., 1852, 243. Type, *A. tomentosus* Dana. Tahiti or Upolu, Samoa.

ACTUMNUS PUGILATOR.

Actumnus pugilator A. Milne Edwards, Nouv. Archiv. Mus. Hist. Nat. Paris, ix., 1873, 195, pl. vii., figs. 1-1a. New Caledonia. *Idem.* Rathbun, Biol. Results F.I.S. Endeavour, v., 3, 1923, 126, pl. xxvii., figs. 3-4. Pine Peak, Queensland; Platypus Bay, Queensland.

The species occurs on the shelly bank outside the reef at North West Island 20 fathoms deep.

Material.—One female, 15 mm. North West Island, December, 1929.

ACTUMNUS INTEGERRIMUS.

Actaeodes ? integerrimus Dana, U.S. Explor. Exped., xiii., Crust. I., 1852, 201. Atlas, 1855, pl. xi., fig. 7. Sandwich Islands.

Actumnus integerrimus Rathbun, Mem. Mus. Comp. Zool., xxxv., 2, 1907, 56, pl. 1., fig. 12. Tahiti, Paumotu (outer reef).

The species occurs in considerable numbers in the small holes in the *Lithothamnium* on the New Caledonian zone. The Australian examples have been compared with the photographed individual in the National Museum, Washington.

Material.—Four females, 6 mm.; one male, 5 mm. North West Island, May, 1930.

Genus ERIPHIA.

Eriphia Latreille, Nouv. Dict. Hist. Nat., xx., 1817, 404.

Eriphia Latreille, Rathbun, Bull., 152, U.S. Nat. Mus. Washington, 1930, 545.

Type, *E. spinifrons* (Herbst) = *Cancer spinifrons* Herbst. Adriatic.

ERIPHIA SEBANA.

Cancer sebanus Shaw, in Shaw and Nodder, Nat. Misc., xv., 1803, pl., 591.

Eriphia sebana (Shaw) McNeill and Ward, Rec. Aust. Mus. Sydney, xvii., 9, 1930, 381. New South Wales.

Material.—Two females, 15 and 19 mm.; one male, 21 mm. Heron Island, September, 1926.

Genus TRAPEZIA.

Trapezia Latreille, Encyc. Method, xx., 1825, 695.

Trapezia Latreille, Rathbun, Bull., 152, U.S. Nat. Mus. Washington, 1930, 556. Type, *T. dentifrons* Latreille, 1825. = *T. cymodoce* (Herbst, 1801). East Indies.

TRAPEZIA FERRUGINEA VAR., AREOLATA.

Trapezia areolata Dana, Proc. Acad. Nat. Sci. Philadelphia, 1852, 83, and U.S. Explor. Exped., xiii., Crust. I., 1852, 259. Atlas, 1855, pl. xv., figs. 8a-b, 9. Sooloo Sea; Tahiti.

Trapezia ferruginea areolata Dana, Ortmann, Zool. Jahrb. Syst., x., 1897, 203-206. Ceylon; Nicobars; Java; Celebes; Sulu Sea; Liu Kiu Islands; Pelew Islands; New Guinea; New Caledonia; Fiji; Samoa Islands and Tahiti, Amboina.

Trapezia ferruginea var. *areolata* Dana, Alcock, Journ. Asiat. Soc. Bengal, lxvii., II., 1, 1898, 221. Andamans; Nicobars; Ceylon and Mergui Arch.

As noted elsewhere, this species is associated with certain living corals in the lagoon zone, and the net work of fine lines on its body and limbs harmonise with the environment.

Material.—One male, 11 mm. North West Island, November, 1927. One male, 11 mm.; two females, 11 and 15 mm. Heron Island, September, 1926. One male, 13 mm. North West Island, May, 1930.

TRAPEZIA DIGITALIS.

Trapezia digitalis Latreille, Ency. Method. Hist. Nat. Entom., x., 1825, 696. Red Sea.

Trapezia digitalis Latreille, Rathbun, Bull., 152, U.S. Nat. Mus., 1930, 559. Lower California, Mexico to Panama, Red Sea to Indo-Pacific region.

The carapace in this species is creamy white in colour and the limbs are brown.

Material.—Three males, from 7 to 10 mm. Heron Island, September, 1926. One female, 10 mm. Hoskyn Island, November, 1927. One male, 11 mm. Heron Island, September, 1926.

TRAPEZIA CYMODOCE.

Cancer cymodoce Herbst, Krabben. III., ii., 1801, 22, li., fig. 5. East Indies.

Trapezia cymodoce (Herbst) Alcock, Journ. Asiat. Soc. Bengal, lxvii., II., 1, 1898, 219, and synonymy. Andamans; Nicobars, Mergui; Palk Straits and the Mekran Coast; Indo-Pacific.

This is the commonest species of the genus in the locality where it inhabits the living coral masses.

Material.—Eight females, from 10 to 20 mm.; six males, 8 to 20 mm. Heron Island, September, 1926. Two males, 10 and 13 mm.; two females, 13 and 18 mm. One Tree Island, November, 1927. One female, 14 mm.; one male, 14 mm. Lady Musgrave Island, November, 1927. One male, 13 mm. Heron Island, September, 1926. One male, juv., 11 mm. Hoskyn Island, September, 1927.

Genus TETRALIA.

Tetralia Dana, Sillimans Americ. Journ. Sci. and Art (2), xii., 1851, 128; Proc. Acad. Nat. Sci. Philad., 1852, 83; and U.S. Explor. Exped., xiii., Crust. I., 1852, 261. Type, *T. nigrifrons* Dana. Paumotus. = *T. glaberrima* (Herbst) fide Alcock.

TETRALIA GLABERRIMA.

Cancer glaberrima Herbst, Krabben., I., viii., 1790, 262, pl. xx., fig. 115. Locality unknown.

Tetralia glaberrima (Herbst) Dana, U.S. Explor. Exped. Crust. I., 1852, 263. Atlas, 1855, pl. xvi., fig. 3. Paumotus; Tahiti and Tongatabu.

Tetralia glaberrima (Herbst) Alcock, Journ. Asiat. Soc. Bengal, lxvii., II., 1, 1898, 223. Mergui; Ceylon; Maldives and Mekran Coast.

Tetralia is found inhabiting the finer branching corals of the lagoon zone. The male is usually ivory white on the carapace, the limbs pale yellow, faintly tinged with pink. The frontal, anterolateral, and posterolateral margins are jet black. The female has the carapace and limbs pale pink, frontal, anterolateral and posterolateral margins as in the male.

Material.—Two males, 6-9 mm.; one female, 8 mm. North West Island, May, 1930. One male, 9 mm.; one female, 14 mm. Heron Island, September, 1926.

BARRIER REEF EXPEDITION—CUMBERLAND AND
WHITSUNDAY ISLANDS.

An expedition of nature lovers, under the direction of Mr. E. F. Pollock, F.R.G.S., is to leave Sydney on the 19th December next, for Mackay, Queensland, where boats will be joined for the purpose of visiting several islands of the Cumberland and Whitsunday groups, between Mackay and Bowen. The expedition will be away a month, and Mr. Pollock, whose address is at Carrington Avenue, Strathfield, will be pleased to forward a syllabus to anyone who is interested.

Mr. Pollock, who was formerly the Honorary Secretary of the Royal Zoological Society, has organised similar expeditions, to attractive spots, every year since 1925.

THE LANCELETS AND LAMPREYS OF AUSTRALIA.

By GILBERT P. WHITLEY,

Ichthyologist, The Australian Museum, Sydney.

(By permission of the Trustees of The Australian Museum.)

(Plate xiii.)

In the present paper, the taxonomy of the various species of Australian lancelets and lampreys, the lowest forms of recent fish-like animals, is discussed, and each species is figured, either from typical or authentic specimens. Further research may bring to light new records, or even new species * of these creatures in our waters, and it is the aim of this review to render the recognition of such an easy matter. Our knowledge of the lampreys has not progressed very far since Ogilby wrote his masterly Monograph of the Australian *Marsipobranchii*, published by the Linnean Society of New South Wales in 1896, though the researches of Dr. Maskell in New Zealand indicate that perhaps the forms here regarded as *Yarra* may be immature *Geotria*.

Phylum CHORDATA.

Subphylum CEPHALOCHORDATA.

Class LEPTOCARDII (The Lancelets).

Order BRANCHIOSTOMI.

(Amphioxii, Myelozoa, Cirrostomi, and Protochordata of authors.)

Family BRANCHIOSTOMIDAE.

Gonads in two rows. Sympodium ("ventral fin") rayed. Dorsal fin not elevated. Anterior and posterior ends of notochord not produced into a rostrum and urostyle respectively.

Genus BRANCHIOSTOMA Costa, 1834.

Branchiostoma Costa, Ann. Zool. (Cenni Zool.), 1834, 49. Haplotype, *B. lubricus* Costa = *Limax lanceolatus* Pallas, Spic. Zool., x., 1774, 19, pl. 1., fig. 11.

Amphioxus Yarrell, Hist. Brit. Fish., ii., 1836, 468; ed. 2, 1841, 618. Haplotype, *Limax lanceolatus* Pallas.

Amphioxus Bonaparte, Fauna Ital., iii., 1841, Intro., pag. *extrema* (fide Sherborn, Index Anim.). Type, *Limax lanceolatus* Pallas.

Amphioxys Agassiz, Nomencl. Zool., 1846, Index Univ., 18. Emendation for *Amphioxus* Yarrell, 1836. Logotype, *Limax lanceolatus* Pallas, by present designation.

The type-species of this genus is European and not strictly congeneric with the Australian form with symmetrical gonads, which may be defined as a distinct subgenus.

AMPHIPLEURICHTHYS, new subgenus.

Orthotype, *Branchiostoma* (*Amphipleurichthys*) *minucauda*, new species.

Form more elongate and less robust than in *Branchiostoma* and with the myotomes more acutely tapering at each end of the animal. Rostral fin distinguished from the low dorsal fin by a definite notch. Caudal fin reduced to a low fold. Gonads in two lateral series. Epipleura continuous with sides of oral hood and ceasing posteriorly just behind atriopore. Oral

* Whilst this paper was in the press, Franz's description of a new *Bathyamphioxus* came to hand (see page 260, under *Epigonichthys*).

tentacles united by a low web. Sympodium rayed, distinct from epipleura. Snout and tail not produced.

BRANCHIOSTOMA (AMPHIPLEURICHTHYS) MINUCAUDA, new species.

Small-tailed Lancelet.

(Plate xiii., fig. 1.)

Branchiostoma belcheri Günther, Rept. Zool. Coll. Alert, August 1, 1884, 32 (Prince of Wales Island, Torres Strait, Queensland). Not *Amphioxus belcheri* Gray, Proc. Zool. Soc. Lond., pt. xv., May 17, 1847, 35, from Lundu River, Borneo; redescribed by Kirkaldy, Quart. Journ. Micr. Sci., xxxvii., 1895, 313, pl. xxxv., fig. 8.

Branchiostoma belcheri Raff, Zool. Res. Endeavour, pt. iii., 1912, 305. *Id.* Ogilby, Mem. Qld. Mus., v., 1916, 72. *Id.* Hubbs, Occas. Pap. Mus. Zool. Univ. Mich., cv., 1922, 6. Not *Amphioxus belcheri* Gray.

Amphioxus belcheri Willey, Zool. Res., vi., 1902, 724, footnote (Moreton Bay record only). Not *A. belcheri* Gray.

Heteropleuron belcheri Haswell, Rec. Austr. Mus., vii., March, 1908, 35. Not *Amphioxus belcheri* Gray.

Branchiostoma belcheri McCulloch & Whitley, Mem. Qld. Mus., viii., 1925, 127. *Id.* McCulloch, Austr. Mus. Mem., v., 1929, 1. Not *Amphioxus belcheri* Gray.

Myotomes $37 + 14 + 12 = 63$. Agrees in general characters with Kirkaldy's figure of *Branchiostoma belcheri* (Gray), but has the caudal fin reduced to a low fold. The number of gonads is difficult to distinguish as some are missing, but the eighteenth pair occurs below the 28th myotome and there appear to be six or seven behind them. Other characters as in subgeneric definition.

The holotype of this species is a specimen 44 mm. in total length dredged in Port Curtis, Queensland, in December, 1929, by Messrs. Melbourne Ward and William Boardman. Australian Museum, registered No. IA 4190.

Amphioxus belcheri Gray, is a briefly described Bornean species, which has been recorded from Queensland by Günther. Kirkaldy described and figured the species in her excellent revision of lancelets, from which the Queensland form is seen to differ notably in having much reduced caudal fin. Jordan and Snyder (Proc. U.S. Nat. Mus., xxiii., 1901, 727) have wrongly recorded this species from Bass Strait. See also *infra*, p. 264.

Family EPIGONICHTHYIDAE.

Lancelets with a single row of gonads developed on the right epipleuron. Snout and tail not produced or attenuated.

BATHYAMPHIOXUS, new genus.

Orthotype, *Asymmetron australis* Raff.

Gonads uniserial, large. Myotomes less than 60. Body deep anteriorly. Sympodium rayed. Rostral fin separated from the dorsal by a small notch. Dorsal fin-rays extending to beyond level of anus. Caudal sagittiform.

This genus also includes *B. franzi*, nov., from W. Australia (see p. 260).

BATHYAMPHIOXUS AUSTRALIS (Raff.).

Deepwater Lancelet.

(Plate xiii., fig. 2.)

Asymmetron sp. Zietz, Trans. Roy. Soc. S. Austr., xxxii., 1908, 288. Forty miles east of Cape Spencer, South Australia; 100 fathoms.

Asymmetron australis Raff, Zool. Res. Endeavour, pt. iii., August 29, 1912, 303, pl. xxxvii. South of St. Francis Island, Great Australian Bight; 35 fathoms. Paratypes in Australian Museum examined.

Epigonichthys australis Waite, Rec. S. Austr. Mus., ii., 1921, 8, and Fish. S. Austr., 1923, 18, and of later authors.

This species has been well described by Raff, but a new figure of it is here given, prepared from a paratype in the Australian Museum, from south of St. Francis Island, Great Australian Bight. Registered No. IA 4946.

Genus PARAMPHIOXUS Haeckel, 1893.

Paramphioxus Haeckel, Zool. Forschungs. Austr. (Semon), i., 1893, xiii. and xv. Haplotype, *Branchiostoma bassanum* Günther, 1884.

Heteropleuron Kirkaldy, Rept. 64th meet. Brit. Assn. Adv. Sci., 1894, 686. Logotype, *Branchiostoma bassanum* Günther, by present designation. *Id.* Kirkaldy, Quart. Journ. Micr. Sci., xxxvii., 1895, 314.

Dorsal fin low and separated from the rostral fin by a notch. Right epipleural fold continuous with symposium. Seventy or more myotomes.

The generic name *Heteropleuron* was first proposed in 1894 by Kirkaldy in a short paper to which she refers in a footnote in her better known 1895 revision. Hubbs in 1922 selected *H. cingalense* Kirkaldy, 1895, as logotype, but, though that species was described in the earlier paper as *H. singalense*, I am following custom in regarding *Branchiostoma bassanum* as the genotype of *Heteropleuron* Kirkaldy, 1894, thus making it a synonym of *Paramphioxus* Haeckel, 1893.

PARAMPHIOXUS BASSANUS (Günther).

Southern Lancelet.

(Plate xiii., fig. 3.)

Branchiostoma lanceolatum Günther, Cat. Fish. Brit. Mus., viii., 1870, 513 (Bass Strait specimens only). Not *Limax lanceolatus* Pallas, 1774. *Id.* Johnston, Proc. Roy. Soc. Tasm., 1882, 141 and 1890, 39. *Id.* Lucas, Proc. Roy. Soc. Vict. (2), ii., 1890, 47 (Port Phillip and Westernport, Victoria).

Branchiostoma bassanum Günther, Rept. Zool. Coll. Alert, August 1, 1884, 31. Bass Strait [10-12 fathoms; H.M.S. "Herald"]. New name for *B. lanceolatum* Günther, non Pallas. Types in British Museum. *Id.* Ogilby, Proc. Linn. Soc. N.S. Wales, x., 1886, 695 (off North Head, Port Jackson, N.S. Wales).

Branchiostoma (Heteropleuron) bassanum Kirkaldy, Quart. Journ. Micr. Sci., xxxvii., March, 1895, 314, pl. xxxiv., fig. 6.

Amphioxus sp. Sayce, Vict. Nat., xviii., 10, 1902, 152. Living with worm in Westernport, Victoria.

Heteropleuron bassanum Willey, Zool. Res., vi., 1902, 725, footnote. *Id.* Haswell, Rec. Austr. Mus., vii., March, 1908, 34.

Heteropleuron (Paramphioxus) bassanus Lönnberg, Thier-Reichs (Bronn), vi., 1, 1905, 242.

Asymmetron bassanum Morris & Raff, Proc. Roy. Soc. Vict. (n.s.), xxii., 1909, 85, pls. xviii.-xx. *Id.* Raff, Zool. Res. Endeavour, pt. iii., 1912, 303, pl. xxxvii., fig. 2 (N.S. Wales to South Australia). *Id.* Flynn, Tas. Nat., ii., 3, 1910, 58 (Schouten's Island, south-east Tasmania).

Epigonichthys bassanus McCulloch, Austr. Zool., i., 7, 1919, 218, fig. 1a, and of later authors.

Kirkaldy noted "Myotomes, maximum number 78, minimum number 70, usual number 75." The large number of myotomes readily distinguishes this species from the other Australian lancelets. Morris and Raff further characterise this species by the possession of a paired postatrioporal caecum.

I have examined specimens in the Australian Museum from the following localities: Port Phillip, Victoria (Bracebridge Wilson, Haswell); east coast of Flinders Island and East Sister Island, Bass Strait ("Endeavour"); Port Stephens (Old Collection), Shoalhaven Bight ("Endeavour"), and Montague Island, New South Wales (Hedley). Surface to seven fathoms or more.

MERSCALPELLUS, new genus.

Orthotype, *Heteropleuron hedleyi* Haswell, 1908.

Notochord extending a short distance beyond the myomeres anteriorly and posteriorly, but not forming a club-shaped terminal or a urostyle. Rostral fin not distinguished from the dorsal fin by a notch. Preoral tentacles forming a continuous series. Dorsal fin low, its rays becoming obsolete before the vertical of the anus. Less than sixty myotomes. Rays of symposium obsolescent. Caudal fin slightly elevated above and below, not attenuated beyond notochord.

MERSCALPELLUS HEDLEYI (Haswell).

Hedley's Lancelet.

(Plate xiii., fig. 5.)

Heteropleuron hedleyi Haswell, Rec. Austr. Mus., vii., 1, March 9, 1908, 33, fig. 1. Murray Island, Queensland; 5-8 fathoms. *Id.* Raff, Zool. Res. Endeavour, pt. iii., 1912, 305.

Epigonichthys hedleyi Ogilby, Mem. Qld. Mus., v., 1916, 72, and of authors. *Id.* Whitley, Rec. Austr. Mus., xvi., 1927, 3 (Michaelmas Cay, Qld.; 2 fathoms).

Myotomes $33 + 11 + 10 = 54$. Gonads 19. Oral cirrhi 25-30. Velar tentacles 10-12.

Form elongate, compressed, with low dorsal fin and expansive epipleura. Rostral fin confluent with the dorsal, which is rayed as far back as about the fortieth myotome. Preoral tentacles longest below and connected by a broad web. Velar tentacles short. Pharyngeal gill-slits very numerous. Opening of oral hood opposite the fifth myocomma. Atriopore at the base of the thirty-third myotome. Anus on left side at base of forty-fourth myotome. Notochord not club-shaped anteriorly or produced posteriorly. Symposium continuous with right epipleuron, but not well developed and with only incipient ray-formations. Caudal slightly expanded. Gonads nineteen, in a single row on the right epipleuron.

Described and figured from the lectotype of the species, the better preserved of two co-types, 28 mm. long, in the Australian Museum; registered No. I. 9254. These were collected by the late Charles Hedley and Allan R. McCulloch at Murray Island, Torres Strait, in 5-8 fathoms. Other Queensland specimens are preserved from Port Denison (Rainford), Michaelmas Cay (Iredale and Whitley), Albany Passage (Ward), and Eagle Island, 3 fathoms, 24th July, 1916 (Hedley and Briggs).

Genus EPIGONICHTHYS Peters, 1877.

Epigonichthys Peters, Monatsb. K. Pr. Akad. Wiss. Berlin, 1876 (1877), 325. Haplotype, *E. cultellus* Peters.

EPIGONICHTHYS CUTELLUS Peters.

Knife-back Lancelet.

(Plate xiii., fig. 4.)

Epigonichthys cutellus Peters, Monatsb. K. Pr. Akad. Wiss. Berlin, 1876 (1877), 325 and 353, pl. —, figs. 1-5. Peale [*i.e.*, Peel] Island, Moreton Bay, Queensland; 8 fathoms (H.M.S. "Gazelle"), and of modern authors.

Branchiostoma cutellum Günther, Rept. Zool. Coll. Alert, August 1, 1884, 32. Moreton Bay and Thursday Island, Queensland. *Id.* Willey, *Amphioxus* and Ancest. Vertebr., 1894, 40.

Epigonichthys pulchellus Tenison-Woods, Fish. Fisher. N.S. Wales, 1882, 187 (Moreton Bay, Queensland). *Lapsus calami*.

Amphioxus cutellus Studer, Zool. Forsch. Gazelle, iii., 1889, 263, pl. xix., figs. 1-5 (Moreton Bay and Thursday Island).

Heteropleuron cutellum Haswell, Rec. Austr. Mus., vii., 1903, 35.

Asymmetron cutellum Raff, Zool. Res. Endeavour, i., 3, 1912, 305.

This species, the monotype of the genus, is easily recognised by the elevated dorsal fin and club-shaped anterior expansion of the notochord. Twelve Queensland specimens in the Australian Museum from Moreton Bay (Ogilby), Bowen (Rainford), Torres Strait (Haswell), Albany Passage and Endeavour Strait (Ward). Franz (Fauna Südwest-Australiens, v., 1927, 219-222, 2 figs.) described *Asymmetron cutellus* ? from Shark's Bay, Western Australia, but his account deals with a distinct species, *Bathyamphioxus franzi*, nov.

Family ASYMMETRONTIDAE.

Elongate and slender lancelets, with the posterior end of the notochord produced into a long urostyle. The gonads are developed on the right epipleuron, and there is a sexual dimorphism in the form of the rostral and caudal fins.

NOTASYMMETRON, new genus.

Orthotype, *Asymmetron caudatum* Willey.

Size considerably larger than in the American genus *Asymmetron* Andrews, 1893. Origin and termination of dorsal fin farther forward in relation to the myotomes.

NOTASYMMETRON CAUDATUM (Willey).

Long-tailed Lancelet.

(Plate xiii., fig. 6.)

Asymmetron caudatum Willey, Quart. Journ. Micr. Sci., xxxix., 2, August, 1896, 219, pl. xiii., figs. 1-4. Deboyne Group, Louisiade Archipelago. *Id.* Willey, Zool. Res., vi., 1902, 725, fig. 14. *Id.* Whitley, Rec. Austr. Mus., xvi., 1927, 1927, 3 (Michaelmas Cay; field notes), and of most authors.

Epigonichthys caudatus Jordan & Seale, Bull. U.S. Fish. Comm., xxv., 1906, 181. Based on Willey, 1896. *Id.* Fowler, Mem. Bishop Mus., x., 1928, 17.

Asymmetron lucayanum Haswell, Rec. Austr. Mus., vii., 1903, 35 (Murray Island record only). Not *A. lucayanum* Andrews, 1893, from the Bahamas.

This attenuated lancelet is easily recognisable, even in the field, by its long, pointed tail. Specimens collected at Michaelmas Cay had the viscera pinkish in colour, showing through the body wall, and giving the lower parts

of the myocommas a pink tinge. The anus was green, and the eye-spot pink, and there was a row of dark hyphen-like marks on the anterior myotomes.

A specimen, 30 mm. long, collected by Hedley and McCulloch at Murray Island, Torres Strait, in 1907, is here figured. Austr. Mus., registered No. I. 9254.

Subphylum CRANIATA.

Branch MONORHINA (*vide* Professor W. J. Dakin).

Class MARSIPOBRANCHII (The Lampreys).

Order HYPEROARTIA.

Family GEOTRIIDAE.

Genus GEOTRIA Gray, 1851.

Geotria Gray, List. Spec. Fish. Brit. Mus., i., Chondropt., pref. July 25, 1851, 137 and 142. Haplotype, *Geotria australis* Gray. *Id.* Gray, Proc. Zool. Soc. Lond., pt. xix., 1851 (published July 26, 1853), 235 and 238.

GEOTRIA AUSTRALIS Gray.

Pouched Lamprey, or Wide-mouthed Lamprey.

(Plate xiii., fig. 7, and text-fig. a (1).)

Petromyzon sp. Grant, Tasm. Journ. Sci., ii., 1846, 392 (Meander River, Tasmania). *Id.* Milligan, Proc. Roy. Soc. V. Diem. Land, i., 1851, 173 and 300 *et ibid.* 1853, 330 (Oyster Cove, etc., Tasmania).

Geotria australis Gray, List. Spec. Fish. Brit. Mus., i., Chondropt., pref. July 25, 1851, 142, pl. ii. "River Inkar pinki, South Australia" = Hobson's Bay (*vide* Castelnau, 1872), or Onkaparinga (*vide* Waite, 1923). Type in British Museum. *Id.* Gray, Proc. Zool. Soc. Lond., 1851 (published July 26, 1853), 239. *Id.* Günther, Cat. Fish. Brit. Mus., viii., 1870, 508. *Id.* Klunzinger, Sitzb. Akad. Wiss. Wien, lxxx., 1, 1879, 429 (King George's Sound, W. Austr.). *Id.* Ogilby, Proc. Linn. Soc. N.S. Wales, xxi., December 22, 1896, 422. *Id.* Dendy & Olliver, Trans. N.Z. Inst., xxxiv., 1902, 147 ("Velasia" stage and metamorphosis). *Id.* Dendy, Rept. 76th meet. Brit. Assn. Adv. Sci., 1906 (1907), 604 (pineal organ). *Id.* Regan, Ann. Mag. Nat. Hist. (8), vii., 1911, 197 (Australian records only). *Id.* Favaro & Mozejko, Tier-Reichs (Bronn), vi., 1, 1913, 534, pl. xxix. *Id.* Leach, Rept. 84th meet. Brit. Assn. Adv. Sci., 1914 (1915), 399, and of authors generally.

Geotria allporti Günther, Proc. Zool. Soc. Lond., June-December, 1871, 675, pl. lxx., Tasmania (Allport). Type in British Museum. Noted by various authors in Proc. Roy. Soc. Tasm., 1865, 77; 1875, 41; 1876, 9; 1881, xxii.; 1882, 141; 1890, 39.

The mouth has a single supraoral lamina and is surrounded by expansive fringes. Labial teeth well separated. A large gular pouch is developed by members of either sex.

Attains a length of 20 inches.

Tasmania, South and South-western Australia; extralimital.

Genus YARRA Castelnau, 1872.

Yarra Castelnau, Proc. Zool. Acclim. Soc. Vict., i., July 15, 1872, 231. Haplo-type, *Y. singularis* Castelnau.

Neomordacia Castelnau, Proc. Zool. Acclim. Soc. Vict., i., July 15, 1872, 232. Haplotype, *N. howittii* Castelnau.

YARRA SINGULARIS Castelnau.

Narrow-mouthed Lamprey.

(Plate, xiii., fig. 8, and text-fig. a (2).)

Geotria chilensis Günther, Cat. Fish. Brit. Mus., viii., 1870, 509 (Swan River record only). Not *Velasia chilensis* Gray, 1851, from Chile.

Yarra singularis Castelnau, Proc. Zool. Acclim. Soc. Vict., i., July 15, 1872, 231. Lower Yarra River, Victoria.

Neomordacia howittii Castelnau, Proc. Zool. Acclim. Soc. Vict., i., July 15, 1872, 232. Cape Shanck, Victoria. Type in Paris Museum.

Velasia stenostomus Ogilby, Proc. Linn. Soc. N.S. Wales, xxi., December, 1896, 409. South-eastern and southern Australia, Tasmania, etc. Type-locality hereby designated Victoria. *Id.* Waite, Rec. Austr. Mus., iv., 1902, 179 (Canning River and off Pinjarrah, W. Australia).

Geotria stenostomus Waite, Rec. Austr. Mus., v., 1904, 232.

Geotria stenostoma Regan, Ann. Mag. Nat. Hist. (8), vii., February, 1911, 197 (Australasian records only). *Id.* Alexander, Journ. Proc. Roy. Soc. W. Austr., vi., 1, 1920, 21, and Herbert, *ibid.*, 23-24, pls. vi.-vii. (ascending river). *Id.* Rauther, Tier-Reichs (Bronn), vi., 1, 39, 1924, 682. *Id.* McCulloch, Austr. Mus. Mem., v., 1929, 2.

Mouth area surrounded by only moderately developed fringes, the submental disc much narrower than in *Geotria*. A single supraoral lamina. Labial teeth close together. No gular sac. Second dorsal fin separated from the caudal.

Most authors are agreed that *Yarra singularis* and *Neomordacia howittii* are names given by Castelnau to young *Velasia stenostomus* Ogilby, but the first name, being the oldest, must be employed for this species. It is not definitely proven that this nominal species is merely a form of *Geotria australis*, but Dr. Maskell's researches in New Zealand indicate that such may perhaps be the case.

An original figure, taken from Waite's Pinjarrah specimen, which is 22 inches long (Austr. Mus., Registered No. I. 4793), is here given. The species is found in Tasmania, Victoria, South and south-western Australia, and attains a length of nearly two feet.

Family MORDACIIDAE.

"Two distant lateral tuberculigerous laminae developed from the upper arch of the annular cartilage" (Gill, Ogilby).

Genus MORDACIA Gray, 1851.

Mordacia Gray, List. Spec. Fish. Brit. Mus., i., Chondropt., 1851, 137 and 143. Haplotype, *Petromyzon mordax* Richardson.

MORDACIA MORDAX (Richardson).

Short-headed Lamprey.

(Plate xiii., figs. 9 and 10, and text-fig. a (3 and 4).)

Petromyzon mordax Richardson, Zool. Voy. Erebus & Terror, Fish. 1846, 62, pl. xxxviii., figs. 3-6. Seas of Van Diemen's Land. Type in British Museum.

Mordacia mordax Gray, List. Spec. Fish. Brit. Mus., i., Chondropt., 1851, 144. *Id.* Ogilby, Proc. Linn. Soc. N.S. Wales, xxi., 1896, 400, and of most authors.

Mordacia sp. Stephens, Abstr. Proc. Linn. Soc. N.S. Wales, May 26, 1886, iv. (Camden, N.S. Wales). Specimen in Macleay Museum, University of Sydney.

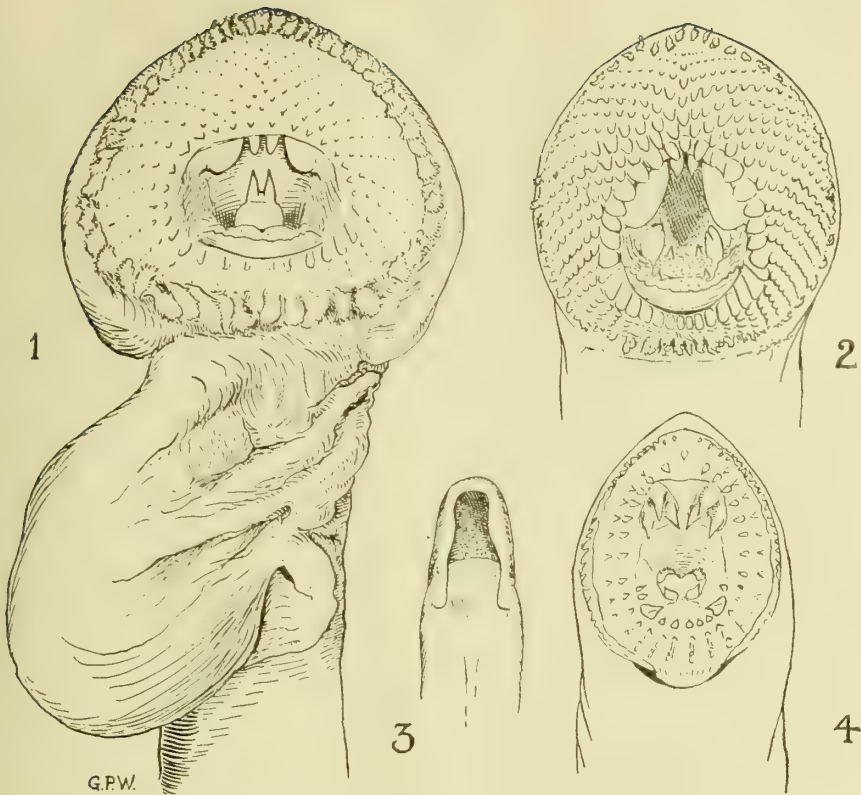


Fig. A.

SUCTORIAL DISCS OF AUSTRALIAN LAMPREYS.

1. *Geotria australis* Gray, from Tasmania (Austr. Mus., Regd. No. I. 9830).
2. *Yarra singularis* Castelnau, from Torrens River, near Adelaide, South Australia (I. 15).
3. *Mordacia mordax* (Richardson). Ammocoetal specimen from Prospect, N.S. Wales (IA. 4951).
4. *Mordacia mordax* (Richardson). Adult specimen from Renmark, South Australia (IA. 2539).

Caragola mordax Waite, Rec. S. Austr. Mus., ii., 1, 1921, 9, fig. 4; Fish. S. Austr., 1923, 20 and fig. *Id.* McCulloch, Austr. Mus. Mem., v., 1929, 3.

Fringes around mouth absent or vestigial. No gular sac. Two supra-oral plates, each bearing about three teeth.

This species is occasionally caught in the Murray River system and gives rise to much needless argument as to the presence or absence of "eels" in that river. The older writers mention it as always being common,

but such is apparently not the case nowadays. In a letter dated 18th December, 1925, Mr. W. S. Coombe, of Renmark, South Australia, stated: "The foreman in charge of the local pumping station informs me that they are very common at the time of the first irrigation in October, but fewer are seen later on during the summer season. The first irrigation began on October 13th this year and then they were very plentiful; now they are not so numerous."

This species grows to a length of about eighteen inches and is found in Tasmania, Victoria, South Australia, and, occasionally, in New South Wales rivers. A young specimen caught with others in the water-pipes of Prospect Reservoir, near Sydney, is here figured to show the eyeless, toothless ammocoetal form.

ADDENDUM.

The New Zealand Lancelet.—From the North Island of New Zealand, Benham (Trans. N.Z. Inst., xxxiii., July, 1901, 121, pl. i.), described *Heteropleuron hectori*, which is typical of *Zeamphioxus*, a new genus allied to *Paramphioxus*, but with more than 80 myotomes, rostral fin sagittiform and caudal fin lanceolate, expanding about midway between atriopore and anus. The fin-ray boxes extend to the end of the fins, though they are unoccupied posteriorly and along the symposium of *Zeamphioxus hectori*.

The Chinese Lancelet, which forms the basis of a fishery at Amoy, has been identified as *Branchiostoma belcheri*?, by A. M. Boring and Hui-lin Li (Peking Nat. Hist. Bull., vi., March, 1932, p. 9, and figs.), but topotypes of *Amphioxus belcheri* Gray, from Borneo, require figuring for comparison, Kirkaldy's best specimens obviously being Queensland forms (*B. (Amphipleurichthys) minucauda*, *supra*, p. 257).—G.P.W., September, 1932.

EXPLANATION OF PLATE XIII.

Fig.

1. *Branchiostoma (Amphipleurichthys) minucauda* Whitley. Port Curtis, Queensland. Type, 44 mm. long. Austr. Mus., regd. No. IA. 4190.
2. *Bathyamphioxus australis* (Raff.). South of St. Francis Island, Great Australian Bight; 35 fathoms. Paratype, 26 mm. No. IA. 4946.
3. *Paramphioxus bassanus* (Günther). Bass Strait. Topotype, up to 43 mm. After Kirkaldy, 1895.
4. *Epigonichthys cultellus* Peters. Torres Strait, Queensland. A specimen 35 mm. or less in length. After Kirkaldy, 1895.
5. *Merscalpellus hedleyi* (Haswell). Murray Island, Queensland. Lectotype, 28 mm. Austr. Mus. Regd. No. I. 9254.
6. *Notasymmetron caudatum* (Willey). Murray Island, Queensland. A specimen 30 mm. long. Austr. Mus., Regd. No. I. 9253.
7. *Geotria australis* Gray. South Australia. Type, 20 inches long. After Gray, 1851.
8. *Yarra singularis* Castelnau. Pinjarrah, Western Australia. A specimen 22 inches long. Austr. Mus. Regd. No. I. 4793.
9. *Mordacia mordax* (Richardson). Tasmania. Type, 10½ inches. After Richardson, 1846.
10. *Mordacia mordax* (Richardson). Prospect Reservoir, New South Wales. Ammocoetal specimen, 79 mm. long. Austr. Mus. Regd. No. IA. 2689.

All original drawings unless otherwise stated; in the lancelets (figs. 2-5) the gonads of the right side are depicted as showing through the body.

NOTES ON SOME REPRESENTATIVES OF THE ASTEROID
GENUS *CULCITA*.

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(With the permission of the Trustees of the Australian Museum.)

The purpose of this contribution is to add to our knowledge of the representatives of the complex genus *Culcita* so as to lighten, in some degree, the task of future workers when endeavouring to formulate a better and more comprehensible classification.

Much has already been written on the genus, but continued effort seems essential before the vast array of variation can be subjected to a classification.

Fisher's (1) remarks that *C. novaeguineae* "appears to be in a state of flux" seems to be very true, but his belief that "every new specimen of *Culcita* seems to augment rather than relieve the difficulties relative to the species problem" does not hold good in most cases if the specimens before me are any criterion. For the most part, the present series of specimens supports the views expressed by Döderlein (2) and later followed by Goto (3).

The specimens herein dealt with are housed in the Australian Museum, Sydney.

CULCITA NOVAEGUINEAE VAR. *TYPICA*.

Culcita novaeguineae Müller and Troschel, Syst. der Asteriden, 1842, 38.

Culcita novae-guineae var. *typica* Döderlein (in Semon) Zool. Forschungsrr. in Austr. und dem Malay Archip., v. (Jena Denkschr., viii.), 1896, 315, pl. xix., figs. 3, 3a.

Culcita novae-guineae var. *typica* Goto, Journ. Coll. Sci., Tokyo, xxix., Art. I., 1914, 517.

Culcita novaeguineae Forma *novaeguineae* Fisher, Bernice P. Bishop Museum, Bull., xxvii., 1925, 70.

(Pl. xv., fig. 3; pl. xvi., fig. 6; pl. xvii., fig. 4.)

Two specimens, considered referable to the typical form, are before me. One is labelled "South Seas" and has much in common with Döderlein's figures. It fits exactly into the var. *typica* section of Goto's key. In a dry condition R. = 116 mm. The body is pentagonal, swollen and ridged interradially, with a slight bulge interrally near the margin as shown in Döderlein's Fig. 3a.

The non-poriferous areas on the abactinal surface of the specimen are practically as shown in Fig. 3, and the contained spinelets are also similar in both size and distribution. The spinelets on the poriferous or papular areas do not appear to be so numerous, or of such an even size, as depicted in Döderlein's Fig. 3. On the whole they are a little larger, apparently approaching closer to Fisher's (*loc. cit.*) specimen from Johnston Island, but not so closely to Döderlein's Fig. 7 on pl. xix., as Fisher thought was possible

(1) Fisher, Bernice P. Bishop Museum, Bull., xxvii., 1925, 70.

(2) Döderlein (in Semon) Zool. Forschungsrr. in Austr. und dem Malay Archip. (Jena Denkschr., viii.), v., 1896, 315, etc.

(3) Goto, Journ. Coll. Sci. Tokyo, xxix., Art. I., 1914, 515 onward.

with his specimen. The spinelets on the non-poriferous areas are generally greater in size than those on the poriferous areas. As in Fisher's Johnston Island specimen, the whole abactinal surface is covered by a fine, close, and distinctly conical granulation, from which arise conical spinelets and numerous upright two-jawed pedicellariæ.

The pedicellariæ are similar to those described by Fisher, being "higher than wide, with the broadened, rounded tops bent tongs-like toward one another." They are fairly abundant and rise most definitely above the general granulation, but they are not as high as any of the surrounding spinelets.

The actinal surface is the same as in Döderlein's Fig. 3a, except that the present specimen does not possess the evenly radiating furrows so clearly shown in that figure; the furrows, where present, are uneven and irregular. It seems reasonably certain that this character is governed by the methods of drying and the amount of shrinkage undergone in the process.

The second specimen of the typical form was collected in the New Hebrides near where the type of *acutispinosa* was secured. It has, however, characters which at once separate it from that variety. The specimen conforms to the requirements of the typical form, as set out in Goto's key, and agrees with Döderlein's Fig. 3 in all important points. The variation to be seen on the abactinal surface is confined to the number of spinelets present. There are fewer spinelets present on this example than shown in Fig. 3, and even less than in the first example described above. The conical spinelets carried on the non-poriferous areas appear to be present in almost normal numbers, the paucity of the spinelets being most apparent on the poriferous areas. Actinally, this specimen from the New Hebrides has the radiating furrows developed a little better and more regularly than in the first specimen, and almost as well as those shown in Döderlein's Fig. 3a.

Localities.—"South Seas" (Austr. Mus., Reg. No. G. 7741); Southwest Bay, Malekula, New Hebrides (Austr. Mus., Reg. No. J. 3170).

Distribution.—Amboina to Samoa.

CULCITA NOVAEGUINEAE VAR. *ACUTISPINOSA*.

Culcita acutispinosa Bell, Ann. Mag. Nat. Hist. (5), xii., 1883, 344.

Culcita novae-guineae var. *acutispinosa* Döderlein (in Semon) Zool. Forschungen. in Austr. und dem Malay Archip., v. (Jena Denkschr., viii.), 1896, 315, pl. xx., figs. 8, 8a.

? *Culcita acutispina* Whitelegge, Mem. Austr. Mus., iii., 1897, 157.

Culcita novae-guineae var. *acutispinosa* Goto, Journ. Coll. Sci. Tokyo, xxix., Art. I., 1914, 517.

Culcita novae-guineae forma *acutispinosa* Fisher, Bernice P. Bishop Museum, Bull., 27, 1925, 71.

(Pl. xiv., fig. 5; pl. xvi., fig. 3; pl. xvii., fig. 5.)

Only when additional records and figures are published will one be able to obtain some idea as to the extent of the irregularities of this variety. To-day we know very little about it, and even Bell's description gives but scanty information. The variety is at present recognised by the continuous papular areas and the smallness and irregularity of the scattered non-poriferous areas; also by the presence of numerous coarse spinelets uniformly distributed, or nearly so, over the entire abactinal surface.

It must be admitted that this diagnosis is very elastic and can be made to meet a number of types all different in some degree. As a proof of this

one need only look at the records of the variety to date. However, it would seem at present, as we have no information available to point to the contrary, that all the types so far assembled under the varietal heading (with the possible exception of Whitelegge's record) are referable to the one form, and that obvious differences are due to age and shrinkage during the process of drying.

Döderlein's photographs were obviously prepared from young specimens, hence the differences seen when they are compared with mature examples.

Whitelegge's record of the variety, which he recorded as a full species, is queried in the above synonymy for the reason that his description seems to apply to the typical form or to the var. *plana* rather than the variety *acutispinosa*. A re-examination of Whitelegge's material is impossible as the two specimens have been lost.

The specimen before me was collected in the Solomon Islands, and, although it does not fit exactly into any available description, or compare favourably with either of Döderlein's figures, it possesses many points in common with Fisher's specimen from Agana, Guam.

The body is pentagonal with the "rays" slightly produced. R. = about 84 mm. in a dried condition. The sides are steep, almost upright, and the abactinal surface is slightly convex. The papular areas merge, there being only isolated and irregularly disposed non-poriferous patches. The abactinal granulation, so evident in the typical form, is much less in extent on the present variety, and is confined, for the most part, to the non-poriferous areas.

The entire abactinal surface is covered by a large number of sharp, stout, conical spinelets, a few as large as, but most larger than, the biggest occurring on the typical form. Generally these large spines are 1.75 mm. in height, and as much across the base, including the granulation, which extends up the spinelets for a short distance. In certain places near the margins the spines are arranged in lines, giving the surface a reticulated appearance. In no respect is the reticulation the same in character as in other varieties. Again, no such formation is seen anywhere but near the margins. As in Fisher's specimen, the pedicellariæ are smaller and narrower than those of the typical form. The pedicellariæ are extremely abundant, so much so that they appear to take the place of the usual granulation.

Actinally the specimen fits the description given by Fisher for his specimen from Guam so perfectly that nothing more need be added.

Locality.—Government Station, Tunabuli Harbour, Ysabel Island, British Solomon Islands, July, 1925 (Austr. Mus., Regd. No. J. 4732).

Distribution.—New Hebrides; Viti Islands; Guam; Ysabel Island, British Solomon Islands; ? Funafuti, Ellice Islands.

CULCITA NOVAE-GUINEAE VAR. TYPICA-ACUTISPINOSA.

Culcita novae-guineae var. *typica-acutispinosa* Döderlein (in Semon) Zool. Forschungr. in Austr. und dem Malay Archip., v. (Jena Denkschr., viii.), 1896, pl. xx., fig. 7.

(Pl. xv., fig. 2; pl. xvi., fig. 2; pl. xvii., fig. 1.)

This *Culcita* was collected at Southwest Bay, Malekula, New Hebrides, along with one described above, under the heading of the typical form. It agrees with no known member of the genus better than with the one figured

by Döderlein in the reference above, and, judging by its peculiarities, appears to represent a phase between the typical form and the var. *acutispinosa*.

The abactinal spinulation is, for the most part, the same as in the var. *typica*, except that it is a little denser. It has, however, the continuous papular areas so characteristic of the var. *acutispinosa*.

The fact that the specimen was collected in the New Hebrides, and that it may be Bell's *acutispinosa*, has not been overlooked. With so little information available the question is difficult to decide, and for the present I have arrived at a judgment founded upon Döderlein's work. If the present specimen is ultimately found to be Bell's variety some change will have to be made in regard to the specimen mentioned elsewhere in this paper as var. *acutispinosa*.

The specimen has been figured in order to show a comparison between it and its two extremes, var. *typica* and var. *acutispinosa* as here understood. R. = 90 mm. approximately.

Locality.—Southwest Bay, Malekula, New Hebrides (Austr. Mus., Regd. No. J. 3196).

Distribution.—South Sea (Döderlein); New Hebrides.

CULCITA NOVAEGUINEAE VAR. *PLANA*.

Culcita plana Hartlaub, Notes Leyden Museum, xiv., 1892, 84.

Culcita plana Leipoldt, Zeitschr. Wiss. Zool., lix., 1895, 637, pl. xxxii., figs. 10a-b.

Culcita novae-guineae var. *plana* Döderlein (in Semon), Zool. Forschungsr. in Austr. und dem Malay Archip., v. (Jena Denkschr., viii.), 1896, 315, pl. xix., figs. 1-1a; 2-2a; 4.

Culcita novae-guineae plana Fisher, U.S. Nat. Mus., Bull. 100, iii., 1919, 361.

(Pl. xiv., fig. 1; pl. xvi., fig. 4; pl. xvii., fig. 2.)

Four specimens before me are considered referable to this variety. Slight differences are noticeable, but on the whole the characters fall well within the varietal limits.

The first specimen (R. = approximately 92 mm.) bears a locality label "Great Barrier Reef, Queensland," and is identical with Döderlein's Figs. 1 and 1a on pl. xix. The papular areas are roughly circular and are entirely separated by well-defined non-poriferous patches. The non-poriferous patches are provided with a number of stout conical spinelets of large size, but here and there blunt or even flat ones are noticeable. The spinelets generally are not as large as those occurring on the var. *acutispinosa*.

The poriferous areas are armed with a few spinelets, the majority of which are smaller than those occurring on the non-poriferous patches. Poriferous areas near the margins carry a greater number of spinelets than the areas more central in position.

Pedicellariæ are fairly numerous. They are notably shorter and more heavily built than those of any variety of the species.

The second specimen of the var. *plana* before me was identified by Dr. H. L. Clark (4) as *Culcita novae-guineae* and recorded from the "Great Barrier Reef," Queensland. It is the largest of the four available specimens; R. = about 100 mm. as stated by Dr. Clark. Owing, no doubt, to its large dimensions the spinelets on the non-poriferous areas are of consider-

(4) Clark, H. L., Rec. Austr. Museum, xv., 2, 1926, 195.

able size, but not as abundant as in the first specimen described above. All the poriferous areas are separated by well-developed non-poriferous patches and carry conical spinelets of small size. Pedicellariæ are fairly abundant, and, although they are not so stout as those seen on the first specimen, they are not as slender as those on the other varieties of the species.

Actinally this specimen resembles the var. *acutispinosa* in that the tubercles gradually flatten from the mouth, where they are distinctly rounded, toward the margins. Near the margins the tubercles broaden to form a flat polygonal tessellation. Although flat and crowded, the tubercles do not in any place totally obscure the underlying coarse granulation.

A third specimen (R. = approximately 90 mm.) was collected at Ugi, Solomon Islands. It is closest to Döderlein's Fig. 4 on pl. xix. The non-poriferous areas, which effectively separate the poriferous areas, are, for the most part, devoid of the usual granulation, being bare and with the integument leathery and like ebony in appearance. This unusual condition of the specimen is no doubt brought about by its long sojourn in a collection and by wear through handling. In other features the abactinal surface corresponds to that of the first specimen, except that in the present specimen no pedicellariæ can be traced. Even in protected areas, where wear is not apparent, pedicellariæ are absent, and therefore it can be reasonably assumed that they were never present.

The tubercles of the actinal surface, although of average size for the variety, are sparse and consequently widely spaced. Owing to this condition the underlying granulation is very conspicuous. The tubercles exhibit no signs of flattening.

The fourth specimen, which was taken at Palm Island, Queensland, is no doubt referable to the var. *plana*, despite its somewhat variable appearance, due to the smallness of the abactinal spinelets and the flat smoothness of the papular areas. R. = approximately 96 mm. Abactinally it is closest to the first specimen, but there are differences to be seen when a comparison is made. The smallness of the spinelets is most noticeable, but, situated at random on the well-defined non-poriferous areas, are larger and more conical spinelets comparable in size with those occurring on the other specimens of the variety before me. Many of the small spinelets are blunt and rounded; some are flat and not at all conical in shape. The non-poriferous areas are covered by a dense granulation, and are responsible for the isolation of the papular areas. The papular areas contain a few small conical spinelets as a general rule, but there are some areas which are totally unarmed.

The singular smoothness of the papular areas in this fourth specimen is due to the lack of the usual number of minute conical spinelets, the absence of pedicellariæ and the less obvious ruggedness caused by the general granulation rising collar-like around the papular pores.

As in the second specimen, the actinal surface of the present example bears tubercles, which gradually flatten from the region of the mouth outwards toward the margins. Near the margins the tubercles form a polygonal flat tessellation, obscuring most of the underlying granulation.

Localities.—Great Barrier Reef, Queensland (two specimens); Ugi Island, north-east of San Cristoval, British Solomon Islands; Palm Island, near Townsville, Queensland (Austr. Mus., Regd. Nos. J.5139; J.4678; A.11,679; G.3226).

Distribution.—Amboina; Mauritius; Philippines; Viti; New Guinea; Samoa; Sumatra; Queensland.

CULCITA NOVAEGUINEAE var. *ARENOSA*.

- Culcita arenosa* Perrier, Recherches sur les Pedicell., 1869, 66, pl. ii., fig. 6.
Culcita arenosa Perrier, Rev. Stell. Mus. d'Hist. Nat. Paris, 1875, 264.
Culcita arenosa Hartlaub, Notes Leyden Museum, xiv., 1892, 92.
Culcita novae-guineae var. *arenosa* Döderlein (in Semon) Zool. Forschung. in Austr. und dem Malay Archip., v. (Jena Denkschr., viii.), 1896, 315, pl. xix., figs. 5-6.
Culcita novae-guineae var. *arenosa* Bedford, Proc. Zool. Soc. London, 1900, 296.
Culcita novae-guineae var. *arenosa* Goto, Journ. Coll. Sci. Tokyo, xxix., 1914, 517.
Culcita novaeguineae Forma *arenosa* Fisher, Bernice P. Bishop Museum, Bull., 27, 1925, 71, pl. vi.

(Pl. xv., fig. 1; pl. xvi., fig. 5; pl. xvii., fig. 6.)

In the single specimen available *R.* = approximately 86 mm. It was collected at Port Moresby, Papua, and agrees perfectly with Döderlein's Fig. 5 on pl. xix. of the abactinal surface. Judging by the description given by Bedford, the present specimen resembles the one examined by him. Although a few isolated conical spinelets occur on the abactinal surface of the specimen, it lacks the small well-spaced spinelets described and figured by Fisher and set out in Goto's key as occurring on the poriferous areas. These facts point to the conclusion that two phases of *arenosa* are in existence—one with an almost smooth abactinal surface as figured by Döderlein and referred to herein, and one well spinulated as figured by Fisher. Whether the differences are of any significance is a question to be answered when more material is available for examination. In the meantime, it is best to accept the two phases as belonging to the one variety.

The present specimen is roundly pentagonal, with a conspicuously domed abactinal surface. The papular areas merge, but in isolated cases they may be bordered on one or two sides by thin, line-like, non-poriferous patches. Except for a few small conical spinelets, almost unnoticeable, the poriferous areas are relatively smooth. The granulation surrounding the actual papular pores is depressed and even, not conspicuously raised collar-like, as seen in other varieties.

The non-poriferous patches, which are generally irregularly shaped, flattened, and finely granulated, are provided with a few (1 to 16, usually 1-6) bluntly pointed or entirely rounded spinelets of comparatively conspicuous size. Pedicellariæ do not occur.

Actually the specimen is almost inseparable from a specimen of var. *plana* with flattened tubercles.

Locality.—Port Moresby, Papua (Austr. Mus., Regd. No. G. 11,336).

Distribution.—Hawaiian Islands (Sandwich Islands); Amboina; Singapore; Ceram Laut; Papua.

CULCITA GREX.

- Culcita grex* Müller and Troschel, Syst. der Asteriden, 1842, 39.
Culcita grex Perrier, Rev. Stell. Mus. d'Hist. Nat. Paris, 1875, 260.
? *Culcita grex* Bell, Proc. Zool. Soc. London, 1887, 140, 142.
Culcita grex Hartlaub, Notes Leyden Museum, xiv., 1892, 87, pls. i.-ii.
Culcita grex de Loriol, Rev. Suisse Zool., 1., 1893, 382.
Culcita grex Döderlein (in Semon) Zool. Forschungs. in Austr. und dem Malay Archip., v. (Jena Denkschr., viii.), 1896, 316.

Culcita grex Bell, Proc. Zool. Soc. London, 1898, 849.

Culcita grex Goto, Journ. Coll. Sci. Tokyo, xxix., 1914, 517.

(Pl. xiv., fig. 6; pl. xvi., fig. 1; pl. xvii., fig. 3.)

Five specimens, all approximately the same size (R. = 115 mm.), are before me. They agree with existing descriptions and keys, and so well with Hartlaub's excellent figures that no doubt is entertained as to the identity of the specimens. Judging from the present series the species is constant in form, exhibiting no variation, thus making it an easily recognisable *Culcita*.

Having been in Vanikoro, Santa Cruz Group, at the time the above specimens were collected, I am able to give some information regarding the life colours and habits of the species. *Culcita grex* was not found between tide marks. It seemed to prefer the quieter waters outside the fringing coral reefs, where it occurred in abundance in a depth of about four fathoms on beds of sand and loose dead coral. When brought to the surface by divers, examples were seen to be of considerable size, often measuring fourteen inches and more in diameter, and bloated and swollen with water to an amazing degree. When they were taken from the water and placed on the deck of a vessel the water oozed quickly from the mouth, leaving the body flat and limp. From some individuals a small commensal fish (*Carapus homei*) emerged from the stomach along with the ejected water. An earlier note concerning this case of commensalism was accompanied by a figure (5), but through an error specimens of *Culcita schmideliana* var. *africana* were photographed in association with the fish, instead of the specimens of *Culcita grex* before me.

In life the non-poriferous areas, the small spinelets, and the underlying granulation are of a deep yellow brown hue.

The papular areas are darker, owing to the deep brown of the papular pores. The actinal surface, like the greater part of the abactinal surface, is deep yellow-brown in colour. Drying after preservation in alcohol causes the colours to fade and become paler almost to a biscuit shade.

Dried specimens are roundly pentagonal in shape with both surfaces perfectly flat. The species seems to lack the sturdy skeletal structure of its allies, and is more prone to total collapse when taken from the water. The non-poriferous areas are well defined, destitute of large conical spinelets, and clothed only in a very fine granulation. This granulation is, in the main, dense and made up of vast numbers of minute, sharply pointed, elongate, and delicate spinelets. The non-poriferous areas vary in size, but are always sufficiently well developed to isolate the papular areas.

The papular areas are roughly round in outline. They possess several medium-sized spinelets, some of which are conical and some blunt and rounded. The granulation is sparse and of the same character as that seen on the non-poriferous areas. A definite and abrupt line separates the two surfaces.

The tubercles and the underlying granulation on the actinal surface are weakly developed and furnish a striking contrast when compared with other representatives of the genus. Although the tubercles are abundant they rise very little above the general granulation and are always only

(5) Troughton and Livingstone, Austr. Mus. Magazine, iii., No. 4, 1927, 120.

slightly rounded. The granulation is fine and separates the tubercles much as in other species of *Culcita*.

Locality.—Three to four fathoms off the mouth of Sunday River, Vanikoro Island, Santa Cruz Group, August, 1926 (Austr. Mus., Regd. No. J. 5106).

Distribution.—? Andaman Islands; Bay of Amboina; Funafuti and Rotuma, Ellice Group; Moluccas; Vanikoro, Santa Cruz Group.

EXPLANATION OF PLATES.

Plate xiv.

- Fig. 1. *Culcita novaeguineae* var. *plana* Hartlaub. Portion of abactinal surface of specimen from the Great Barrier Reef, Queensland (Austr. Mus., Regd. No. J. 5139). Half natural size.
- Fig. 2. *Culcita novaeguineae* var. *plana* Hartlaub. Portion of abactinal surface of specimen from Palm Island, Queensland (Austr. Mus., Regd. No. G. 3226). Slightly over half natural size.
- Fig. 3. *Culcita novaeguineae* var. *plana* Hartlaub. Portion of abactinal surface of specimen from the Great Barrier Reef, Queensland (Austr. Mus., Regd. No. J. 4678). Two-thirds natural size.
- Fig. 4. *Culcita novaeguineae* var. *plana* Hartlaub. Portion of abactinal surface of specimen from Ugi, British Solomon Islands (Austr. Mus., Regd. No. A. 11,679). About two-thirds natural size.
- Fig. 5. *Culcita novaeguineae* var. *acutispinosa* Bell. Portion of abactinal surface of specimen from Ysabel Island, British Solomon Islands (Austr. Mus., Regd. No. J. 4732). About two-thirds natural size.
- Fig. 6. *Culcita grex* Müller and Troschel. Portion of abactinal surface of specimen from Vanikoro, Santa Cruz Group (Austr. Mus., Regd. No. J. 5106). About two-thirds natural size.

Plate xv.

- Fig. 1. *Culcita novaeguineae* var. *arenosa* Perrier. Portion of abactinal surface of specimen from Port Moresby, Papua (Austr. Mus., Regd. No. G. 11,336). Three fourths natural size.
- Fig. 2. *Culcita novaeguineae* var. *typica-acutispinosa* Döderlein. Portion of abactinal surface of specimen from Southwest Bay, Malekula, New Hebrides (Austr. Mus., Regd. No. J. 3169). About two-thirds natural size.
- Fig. 3. *Culcita novaeguineae* var. *typica* Müller and Troschel. Portion of abactinal surface of specimen from Southwest Bay, Malekula, New Hebrides (Austr. Mus., Regd. No. J. 3170). Slightly over half natural size.

Plate xvi.

- Fig. 1. *Culcita grex* Müller and Troschel. Portion of actinal surface of specimen from Vanikoro, Santa Cruz Group (Austr. Mus., Regd. No. J. 5106). Natural size.
- Fig. 2. *Culcita novaeguineae* var. *typica-acutispinosa* Döderlein. Portion of actinal surface of specimen from Southwest Bay, Malekula, New Hebrides (Austr. Mus., Regd. No. J. 3169). Natural size.
- Fig. 3. *Culcita novaeguineae* var. *acutispinosa* Bell. Portion of actinal surface of specimen from Ysabel Island, British Solomon Islands (Austr. Mus., Regd. No. J. 4732). Natural size.

- Fig. 4. *Culcita novaeguineae* var. *plana* Hartlaub. Portion of actinal surface of specimen from Great Barrier Reef, Queensland (Austr. Mus., Regd. No. J. 5139). Slightly under natural size.
- Fig. 5. *Culcita novaeguineae* var. *arenosa* Perrier. Portion of actinal surface of specimen from Port Moresby, Papua (Austr. Mus., Regd. No. G. 11,336). Slightly under natural size.
- Fig. 6. *Culcita novaeguineae* var. *typica* Müller and Troschel. Portion of actinal surface of specimen from Southwest Bay, Malekula, New Hebrides (Austr. Mus., Regd. No. J. 3170). Slightly under natural size.

Plate xvii.

- Fig. 1. *Culcita novaeguineae* var. *typica-acutispinosa* Döderlein. Enlarged section of abactinal surface of specimen from Southwest Bay, Malekula, New Hebrides (Austr. Mus., Regd. No. J. 3169). X 3.
- Fig. 2. *Culcita novaeguineae* var. *plana* Hartlaub. Enlarged section of abactinal surface of specimen from Great Barrier Reef, Queensland (Austr. Mus., Regd. No. J. 5139). X 3.
- Fig. 3. *Culcita grex* Müller and Troschel. Enlarged section of abactinal surface of specimen from Vanikoro, Santa Cruz Group (Austr. Mus., Regd. No. J. 5106). X 2.5.
- Fig. 4. *Culcita novaeguineae* var. *typica* Müller and Troschel. Enlarged section of abactinal surface of specimen from Southwest Bay, Malekula, New Hebrides (Austr. Mus., Regd. No. J. 3170). X 3.
- Fig. 5. *Culcita novaeguineae* var. *acutispinosa* Bell. Enlarged section of abactinal surface of specimen from Ysabel Island, British Solomon Islands (Austr. Mus., Regd. No. J. 4732). X 2.
- Fig. 6. *Culcita novaeguineae* var. *arenosa* Perrier. Enlarged section of abactinal surface of specimen from Port Moresby, Papua (Austr. Mus., Regd. No. G. 11,336). X 2.

A NEW SPECIES OF *FROGGATTIMYIA* TOWNSEND.

Family TACHINIDAE (Diptera).

By J. R. MALLOCH.

FROGGATTIMYIA *ANGULIVENTRIS*, n.sp.

Male and female.—Head black, interfrontalia reddish but obscured by the grey dust, the parafacials and jowls reddish to brownish testaceous, slightly shining, but quite densely grey dusted; antennae black, the extreme apex of second and but a narrow line at base of third segment reddish; palpi testaceous yellow. Hairs and bristles black, the occipital hairs white, postocular cilia dark. Thorax and abdomen black, slightly shining, with rather dense grey dust, the abdomen in the male with the sides of first and second visible segments usually rather distinctly red. Mesonotum with four black vittae; apex of scutellum reddish; all hairs and bristles dark. Legs black. Wings greyish hyaline. Squamae white, the margin yellow. Halteres dark brown to fuscous.

Frons of male about one-sixth of the head width at vertex, widened to anterior extremity, with two strong verticals, no developed postverticals nor ocellars, one or two recurved upper orbitals and a series of inner marginal incurved bristles on each orbit which diverge below base of antennae

and extend to or almost to level of apex of second antennal segment, the orbits and parafacials quite densely haired on their entire extent; frons of female about one-fourth of the head width at vertex, with all four verticals strong, a weak pair of postverticals and a stronger pair of divergent ocellars, the usual recurved upper and two proclinate bristles in each of the outer series, a series of strong incurved inner margins on each orbit, which are in two series anteriorly, the parafacials and orbits not as densely haired as in the male, the former haired to lower level of eye; antennae of female distinctly longer than in the male, third segment about four times longer than second as against three times longer in male, the third segment rather narrow; arista bare; face with a poorly developed central carina; eyes bare; parafacials about twice as wide as third antennal segment and about half as wide as height of gena; vibrissae above level of epistome and almost in line with lower level of eye.

Thorax as in other species of the genus, the hairs on centre of propleura quite dense, all dark.

Abdomen of male normal, ovate, that of female more elongate than usual, the apex conical, fourth visible tergite on its median line fully as long as the remainder of abdomen at same point, the third tergite narrowed centrally, widened on sides (Fig. 1).

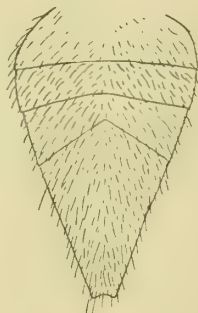
Fore tarsi of male normal, the claws elongated slightly, longer than those of mid and hind tarsi, the female with the fore tarsi slightly widened from near base, the fifth segment slightly longer than wide, the pulvilli very small and the claws rudimentary, visible only under a high power lens.

Third wing vein with four or five setulae at base above and below.

Length, 8.5-11 mm.

Type, female, allotype, and 15 paratypes, reared from larvae of *Paropsis reticulata* Marsh., various dates in March, April, and May, 1932, Canberra (F.C.T.).

This species will run down to *tillyardi* in my key* to the species of the genus, but is distinguished therefrom by the entirely black fore tarsi and the fact that the vibrissae are a little closer together than either is from the nearest part of the eye. I have seen no other species of the genus in which the abdomen is of similar structure in the female, though there may be such as some of the species are unknown to me in that sex. It may be well to note here the distinctions in the chaetotaxy of the frons in the sexes as not infrequently the lack of the ocellar bristles is considered as of value as a generic character. In no male before me are there distinguishable ocellar bristles, while in all females these are well developed. The postverticals may be represented by two or more erect setulose hairs in some of the males, but they are not as strong as the bristles in the females.



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* To be published in my paper, Notes on Australian Diptera, xxxiv., in the Proceedings of the Linnean Society of N.S. Wales.

SOME NEW AUSTRALIAN SARCOPHAGID FLIES:
AND NOTES ON OTHERS.

By G. H. HARDY.

Walter and Eliza Hall Fellow in Economic Biology, Queensland
University, Brisbane.

As the genus *Sarcophaga* has come into prominence again in Australia, being associated more widely than hitherto with economic problems, it is advisable to publish the following new species. Since the revision of this group by Johnston and Hardy, in 1923, four more species have been discovered, and in addition there are two species known that are suspected importations, but I am unable to associate the genitalia of these with any published figures.

The genus *Sarcophaga*, in its widest sense, but not accepted as such in the previous papers, contains *Helicobia australis*, Johnston and Tiegs, but that species is not congeneric with the remainder in Australia, and it is preferable to retain it apart. The generic name *Helicobia* is a synonym of *Sarcophaga*, as accepted by most authors, and I have been unable to associate the typical form with the Australian species placed under the name, although the two species have some characters in common. I retain the name *Helicobia* as being one of convenience, rather than propose a generic name at the present time, because there is no unanimous opinion with regard to the limits of the various associated genera. The two concepts may be distinguished as follows:—

Vein R1 with a row of bristles. Only three postsutural dorsocentral bristles *Helicobia australis*, J. & T.
Vein R1 bare. Four postsutural dorsocentral bristles and often a fifth is present *Sarcophaga*, spp.

This applies only to the Australian element and cannot be applied successfully to the world forms, but there is a tendency shown in the works of various authors to limit the genus *Sarcophaga*, and so the sinking of the two above under one generic name would be premature.

SARCOPHAGA ALCICORNIS n.sp.

The outer vertical bristle on the head is present, and there is only one postocular row. The presutural and prescutellar acrostichals, one presutural and three intraalar occur on the thorax. One row of strongly developed discal laterals occurs on the first abdominal segment. In other respects the chaetotaxy agrees with that of other species in the genus.

The aedeagus contains a well developed lobe, a bifid lateral process and a trifid apex. The last has on each side a rearwardly directed process which is two-pronged on one and three-pronged on the other, giving the general shape of an elk-horn, and is an outstanding character. The forceps are strongly curved and the claspers are about equal in length; the anterior one has a small flange on its basal half.

This fly has the average appearance of all Australian members of its genus with a strong tendency towards the golden tone.

Habitat.—Queensland: Brisbane, 1931. One male. This fly was originally discarded, and its nature was discovered some months later and then labelled. There is no doubt about its locality being Brisbane, however, as no *Sarcophagas* were secured from elsewhere over the period.



Fig. 1.
Sarcophaga alcicornis.
 (See explanation.)

SARCOPHAGA SPINIFERA n.sp.

The outer vertical bristle is not developed and there are two postocular rows. The presutural acrostichals are probably absent, but the pin has penetrated too near this region to be certain. The prescutellar acrostichals, two presuturals and two intraalar bristles are present. On the first abdominal segment there is one row of discal laterals. In other respects the chaetotaxy agrees with that of other species.

The genitalia contain normal shaped forceps and the claspers are of equal length, the anterior one having a slight flange. The aedeagus is very unusual, being provided with a tomentose covered apical area that is depressed and out of the depression arises a row of thick angulated spines, this being the most outstanding character.

The fly bears the same appearance as others in the genus with the golden coloration only slightly developed. It is one of the so-called grey forms, but much darker than the exotic ones that are truly grey.

Habitat.—Queensland: Brisbane, December, 1929. One male.



Fig. 2. *Sarcophaga spinifera*.
(See explanation.)

SARCOPHAGA FURCATA n.sp.

The outer vertical bristles are not developed and there is only one postocular row of bristles. The presutural and prescutellar acrostichals, two presutural and two intraalars are present. On the first abdominal segment the discal laterals form into two rows of bristles. In other respects the chaetotaxy conforms to the normal type.

The aedeagus seems to be without the usually developed lobe, but there is a strong lateral spine-like projection that occurs near that area. The lateral process is probably represented by processes that lie adjacent to the

apex and are reminiscent of those that occur on *S. epsilon* J. & T. The trifold apex contains two pairs of small lateral processes, comparable to similar structures on *S. howensis* J. & H., and there are no filaments perceptible. The forceps are strongly developed and curved as in the *antilope*-group. The anterior clasper is very long, with a short lateral branch, and the posterior clasper is long but simple.

The fly tends towards being one of the so-called golden ones, but the colour on the frons and on the majority of the thorax is too pale to permit it to be so classed.

Habitat.—Queensland: Brisbane, December, 1929. One male.

Note.—The remarkable resemblance this fly bears to the *antilope*-group leads me to suggest placing it there. It misses the small knob near the anterior clasper, but the forceps, bifid anterior clasper with the cleft that does not reach to the base, associated with the trifold apex of the aedeagus would bring the species near *S. beta* J. & T., *S. howensis* J. & H., and *S. antilopoides* Hardy. There are a number of characters that will distinguish it from these, the lack of the protruding filament and the long anterior clasper being the most noticeable.



Fig. 3. *Sarcophaga furcata*.
(See explanation.)

SARCOPHAGA ALBICEPS-group.

The character that most readily allies all forms that come under this group is found in the shape of the anterior appendage. This arises from a slender stalk expanding abruptly into a plate that is often with the appearance of being cup-formed, but with two diverging long processes on the anterior edge. As far as I have gathered them, the names of the various species belonging here are:—

albiceps Meigen, 1826, Europe.

hirtipes Wiedemann, 1830, Egypt.

rufipes Wiedemann, 1830, Egypt.

ochidea Bottcher, 1913, Formosa.

knabi Parker, 1917, Philippine Islands.

gamma Johnston & Tiegs, 1921, Queensland.

froggatti Johnston & Tiegs (nec Taylor), 1921 = *omega* J. & T., Queensland.

omega Johnston & Tiegs, 1921, Queensland.

brunneopalpis Johnston & Tiegs, 1922 = *gamma* J. & T., Queensland.

flavipalpis (var of *knabi*), Senior-White, 1924, India.

prosbaliina Baranoff, 1931.

It will be noted I previously placed *S. knabi* Parker, as probably belonging to the *misera*-group, but that is now shown to be an error. It is further possible that the present group is represented in the Americas by *S. gula* Fabricius, 1805, and the synonyms standing under this name are *hirtipes* Walker, 1852, *lamanensis* Robineau-Desvoidy, 1830, *amerosa* Schiner, 1868, and *wiedemanni* Aldrich, 1916. *S. gula* Fab., is said to be related to *S. bakeri* Aldrich, 1916, but the figures published are not sufficient for me to judge if either be truly related to the *albiceps*-group.

In a letter dated 2nd October, 1928, Mr. R. Senior-White started a correspondence with me affecting the identity of *S. froggatti* and *S. knabi*, expressing the view that these were the same. The species of *S. froggatti*

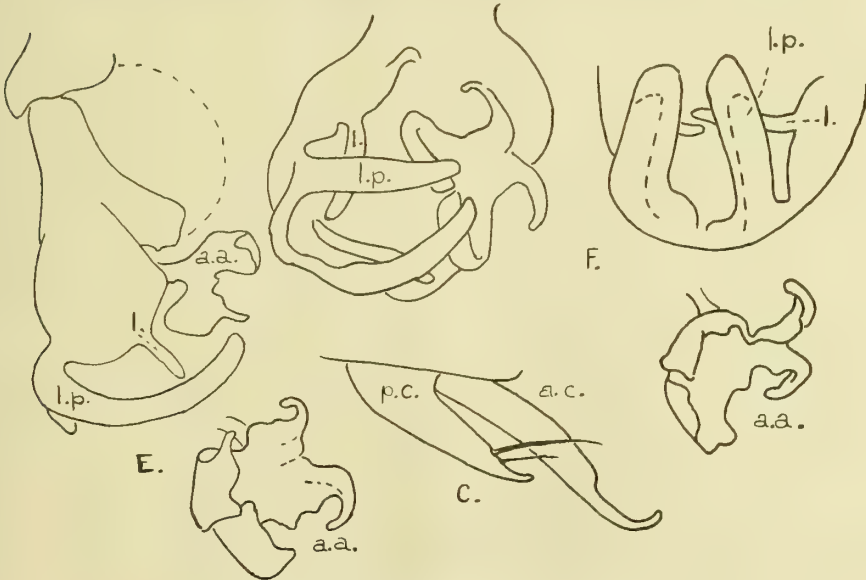


Fig. 4. *Sarcophaga albiceps* group.
(See explanation.)

referred to was that of Johnston and Tiegs, not that of Taylor, and was placed as a synonym of *omega* by Johnston and Hardy, who mentioned a specimen was labelled by Aldrich as *S. knabi*.

As only a few odd specimens were available, I was unable to submit specimens to Mr. White, who instead kindly forwarded to me specimens of forms he identified as *knabi* from India.

I have now made a series of drawings of *S. omega*, *S. knabi* and *S. albiceps* with a view of finding differences in the genitalia and, although several apparent ones were there, these were found to be no more than due to the curvature of the various parts and not to structure.

It seems to me that illustrated differences appearing plausible in literature may be no more than those due to circumstances, and, if my view be correct, then there will not be any structural differences between these three forms to be found in the genitalia. I have taken the fifth sternite into consideration too, but find these do not show consistent characters such as one would expect to find. Mr. White informs me that *prosbatiina* Baranoff, is similarly difficult to distinguish from *S. knabi*, and so presumably it belongs to the same complex.

I would suggest that these forms may represent quite valid species as they fail to conform in certain characters other than genitalia. I have examined the intermediate and posterior femora of the three before me, and I find that very probably the differences pointed out there by Mr. White will be maintained, but if so, then *S. knabi* before me is not conspecific with *S. omega*. In addition, the Australian representative is quite a dark species, whereas the other two are very pale, the face is golden and not yellow, a deeper gold than that on *S. albiceps*.

In the figure given here, the lateral view of the aedeagus of *S. albiceps* is represented by Fig. E, and the ventral view of the anterior appendage is also given to show the comparatively flat nature of this structure. A similar view is given for the anterior appendage of *S. omega*, where the structure is still further curved up, but on following out the lines I find there is not the difference in the outline that might be expected, and both flattened out would come to the same lines.

Another outstanding difference due to circumstances is to be found in a specimen of *S. omega* from Adelaide. Normally, the lateral processes are long, slender and rounded, but on the Adelaide specimen they are flattened out so that the portions that would curve out of sight appear to be flanges attached to that portion that is normally seen. Both forms are illustrated in Fig. F. The holotype of *S. omega* has the lateral processes corresponding to those on the Adelaide specimen.

Fig. C. is a carefully outlined drawing of the claspers on *S. omega*, but I cannot see that these differ structurally from those of the other two species. The two bristles may be both short, or one longer than the other, but invariably both are to be detected. The lobe is liable to undergo differences in appearance, but here again it would seem that no structural differences are to be detected.

At the base of the second segment of the aedeagus there is a large membranous distended portion present on all specimens of *S. omega*, but on the other two species this is largely missing; nevertheless, occasionally it is preserved on specimens that are dried out, but not quite so distended if the material before me is reliable enough for judgment to be formed on it. An outline dotted is shown on Fig. E, to show where this should come, although it is not perceptible on the specimen from which the drawing was made.

LITERATURE.

1923. JOHNSTON & HARDY. A revision of Australian Diptera belonging to the genus *Sarcophaga*. Proc. Linn. Soc. N.S. Wales, xlviii., 94-129.
1927. HARDY. Notes on Australian and Exotic Sarcophagid flies. *ibidem.*, lii., 447-459.
1932. HARDY. Notes of *Sarcophaga peregrina*-group. Bull. Ent. Res., xxiii., 45-48.

The above references, in addition to the references to be found in those works, make a complete list of all the literature on genus *Sarcophaga* that is likely to be needed in the study of the Australian representatives of the genus.

TEXT FIGURES.

Fig. 1. *Sarcophaga alcicornis n.sp.*, lateral view of the genitalia, together with enlarged details (lettered) as follows:—

- A. forceps seen posteriorly.
- B. apex of same seen laterally.
- C. claspers: *a.c.*, anterior clasper.
p.c., posterior clasper.
- E. second segment of the aedeagus seen laterally.
- F. the same seen more ventrally.
- G. the same seen posteriorly and an enlarged outline as seen from a more tilted position.
a.a., anterior appendage.
l., lobe.
l.p., lateral process.

(This lettering is in conformity with that of prior papers and applies to all figures.)

Fig. 2. *Sarcophaga spinifera n.sp.* (lettering as in Fig. 1).

Fig. 3. *Sarcophaga furcata n.sp.* (lettering as in Fig. 1).

Fig. 4. *Sarcophaga albiceps*-group (lettering as in Fig. 1; in addition, E was drawn from a specimen of *S. albiceps*, and the remainder from *S. omega*).

OCCASIONAL NOTES.

By A. S. LE SOUEF.

ANEMONES AT TARONGA.

The Taronga Park Aquarium has been successful in maintaining a splendid show of anemones. Several species are on view from as far separated localities as California, Hawaii, Lord Howe Island, the Solomon Islands and Port Jackson.

The most spectacular is a large dish-shaped form (*Discosoma* sp.?) that came from the Solomon Islands. It is about the size and shape of a large soup plate. It has very short tentacles of even length. When it arrived, about eight months ago, it was sage green in colour, but is now almost pure white. This change in colour has been noted in several species from tropical waters, and I understand that it is due to the tentacles being covered with a small parasite, which seemingly does not thrive in captivity, and when it comes off the animal is left in its natural colour. This change in hue is not due to environment, as the rocks on which the anemone lives in the tank are dark in colour.

The amount of food that these anemones require is surprising. Considering that they are stationary and almost immobile in mind and body, it should not take much to maintain them, but we find that they will take rather more than a fish of similar weight would. The one under review will absorb most of the meat from five prawns daily. These have to be cut up very finely, otherwise the food is not digested. These notes apply to another species from the same locality, but which has longer tentacles.

In the same tank as these anemones are kept many of the specialised anemone fish which are said to be always in association with them. Of these several species are shown. During the day individual fish will be seen worming their way in and out of the folds and tentacles of the anemone. Only two or three, of perhaps one hundred fish, are interested in the anemone, and, as far as can be judged, it is the same fish every day. It is to be noted that other species of fish in the tank never go near the anemones. Practically all our aquarium fish are given at times to wiping their sides on the sand at the bottom of the tank. The anemone fish never do this, but apparently clean themselves, when necessary, on the anemone. At night most of the anemone fish will be seen clustered on the anemones.

Several kinds of truncated anemones from Hawaii, California and Lord Howe Island are also shown. Some of these have also been noted to change in colour from green to white. These also have the same prodigious appetite. One particularly large specimen, about 7 inches across when expanded, only thrives on oysters. We have some difficulty in gauging what is a fair ration. The one mentioned has taken nine large oysters in an hour and a half, and next day seemed ready for more. Truncated anemones seemingly only take oysters, and dish-shaped kinds thrive only on prawns.

The local long tentacled green anemones do well in captivity, staying quietly in fairly deep water in the well-lighted tank. The small red forms, however, do not like deep water or light, for they climb to the top of the tank and make for the darker corner, and even then do not seem happy. The flesh-coloured warted anemones do not live at all in our tanks.

It is noticeable that the anemone fish take no interest in our local

species of anemones. In fact, fish of any kind only go near them at their peril, for quite large specimens are at times caught and eaten, the Seahorse (*Hippocampus*) often falling a victim.

DISPLAY OF THE TWELVE-WIRED BIRD OF PARADISE.

The family *Paradiseidae* is noted for the extremely different types presented by its many genera. In this they resemble the orchids in the botanical world and the Edentata among the mammals.

Probably no family of birds is more given to display than the Birds of Paradise, and the male of each of the genera has a characteristic way of showing off his charms. This is as might be expected, for the different species support elaborate plumage decorations, which they are able to show to great advantage when the mood takes them. Display is not necessarily made to the female, for her presence or absence seems to make no difference to the vigour put into the "show off."

A beautiful pair of Twelve-wired Bird of Paradise (*Seleucidés nigricans*) are at present housed in Taronga Park, and the male often shows off his ornamental plumes. He is strikingly coloured in deep purple-black and yellow, the lower part of the body only showing the latter tint. The chest is covered with a movable fan-like structure, which is margined with metallic green.

Normally, the bird has a characteristic quick movement of the wings, which is operating more or less constantly, apart from display. During display activity is increased. A fantastic dance is indulged in. This consists of running up and down a perch, frequent angular movements of the head and flicking of the wings and semi-erection of the chest fan. The perch is sometimes circled and the body not infrequently hangs upside down. At times the wings are raised and a pair of small crests on the crown are erected. This is all accompanied by tapping the perch with the long bill. The female shows an interest in her mate's charms by sometimes erecting his breast fan with her bill.

CORRESPONDENCE.

BREEDING PARRAKEETS IN CAPTIVITY.

The Hon. Secretary, Royal Zoological Society of New South Wales, Sydney.
Dear Sir,—

I am not aware as to whether it is permissible for you to publish in "The Australian Zoologist" the following notes, written, as they are, by one who is not a member of the Royal Zoological Society of New South Wales. My only excuse for forwarding them to you is that I think it may possibly interest your members to read of the attempts that are being made by the South Australian Zoological Society to breed in captivity, certain Parrakeets which are threatened with extinction in the natural state.

In July, 1930, this Society erected a series of cages which now house a pair each of the following:—

- Neophema elegans* (Elegant Parrakeet).
- Neophema bourkii* (Bourke's Parrakeet).
- Neophema pulchella* (Turquoise Parrakeet).
- Neophema splendida* (Scarlet-chested Parrakeet).
- Psephotus dissimilis* (Hooded Parrakeet).

The Hooded Parrakeet is not particularly rare in the natural state, but last season we were fortunate enough to rear three young out of four

actually hatched. The eggs are laid on alternate days, and the incubation period is 18 to 19 days. The first youngster to leave the nest did so when 30 days old, but the last two did not venture into the open world until 7 days later. Apart from the fact that they are smaller (length at 30 days old, 6.5 inches) the young resemble the adult female as to plumage, but the beak is orange, whilst that of the adult bird is greyish white. The sexes of the young are difficult to distinguish, but the male bird begins to show a brighter blue on the cheeks and a richer orange colour on the under tail-coverts when about six weeks out of the nest.

The Turquoise Parrakeets are proving to be the most prolific of the *Neophema* family. In the 1930-31 season one pair nested twice, rearing three and one respectively. This season the same pair have reared four young in their first nest and have two young in their second brood, which have not yet left the nest. One of the 1930-31 season's hens was mated to a wild caught cock, and so far they have reared in two broods this season, seven young, and, at the time of writing, the hen has just begun to lay her third clutch for the season. It seems that in captivity *Neophema pulchella* is normally double brooded, but it is unusual for them to nest three times in one season. In some broods the sexes of the young can be distinguished almost as soon as they leave the log, but at other times the red on the shoulders of the cocks is not discernible until a fortnight or three weeks after they have left the nest.

The Elegant Parrakeet will breed readily in captivity, but appears to nest only once in a season. Four young were reared last summer, but owing to lack of space no attempt was made to breed them this season.

Four Bourke's Parrakeets were reared this summer. A second pair nested but deserted their young when about twelve days old. Several private persons in Adelaide have bred this species during the present season and many pairs have nested twice.

As far as can be ascertained, it is sixty years since *Neophema splendida* has been kept in captivity, and this is the greatest rarity in our collection of Parrots. The pair consist of an adult female, purchased last August, and a young cock, which was taken from the nest this season and reared by hand. As yet it is smaller than the female, and the scarlet on the chest is patchy and inter-mixed with light greenish-yellow. We believe this bird to be about four months old, and hope to be able to record the breeding of the Scarlet-chested Parrakeet next season.

All the birds that are reared here are rung with numbered rings and careful records are kept so that no in-breeding will occur. With the assistance of others interested in this work, it is hoped that some of these rare birds will be saved from extinction, which with the human occupation of the country and the many imported pests seems almost inevitable unless efforts are made to breed them in captivity. The success with which this venture has been rewarded is an incentive to this Society to make further funds available as soon as circumstances permit.

Yours faithfully,

R. R. MINCHIN,

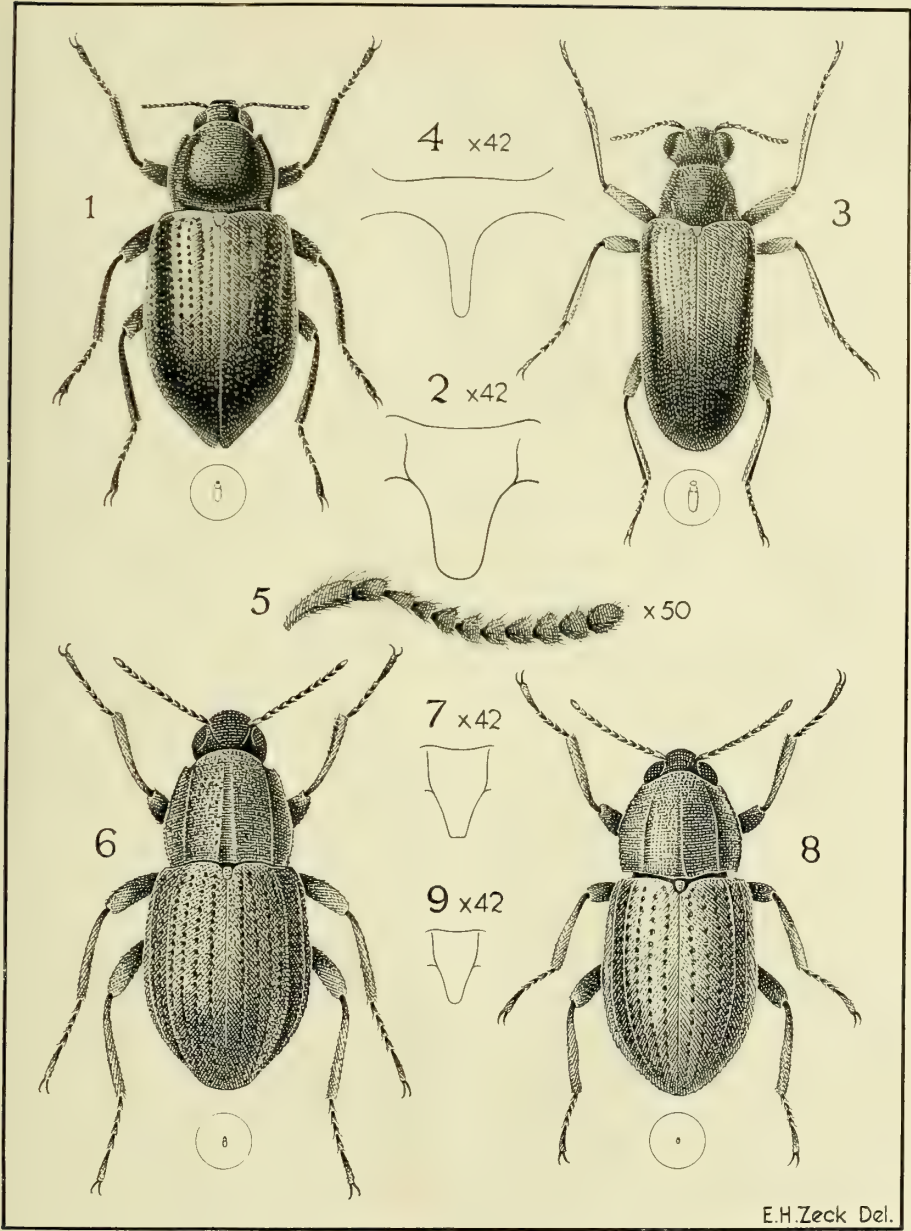
Assistant Director, South Australian Zoological
and Acclimatisation Society's Gardens.

Adelaide, 12th February, 1932.

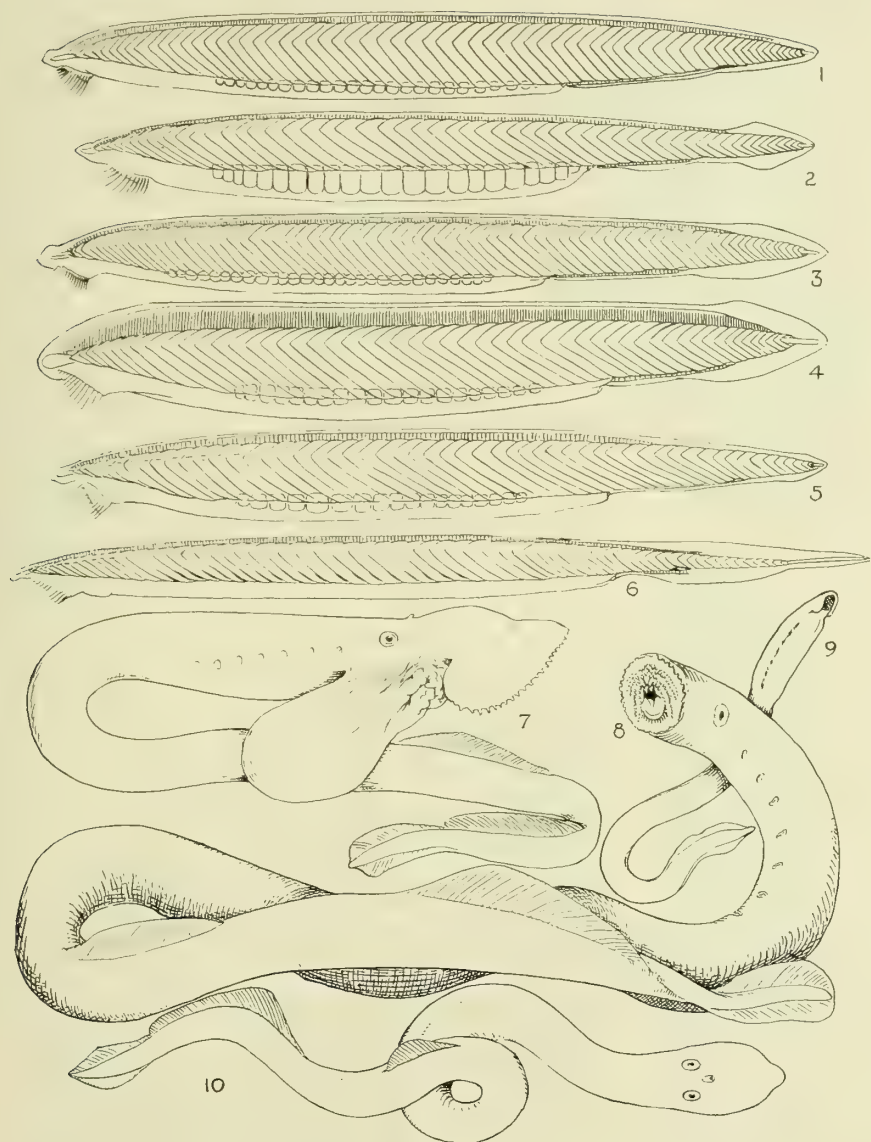
Note: Mr. Minchin has since become an associate member of the Society.



Mosaic Hermaphrodites of *Papilio aegaeus* Donovan.

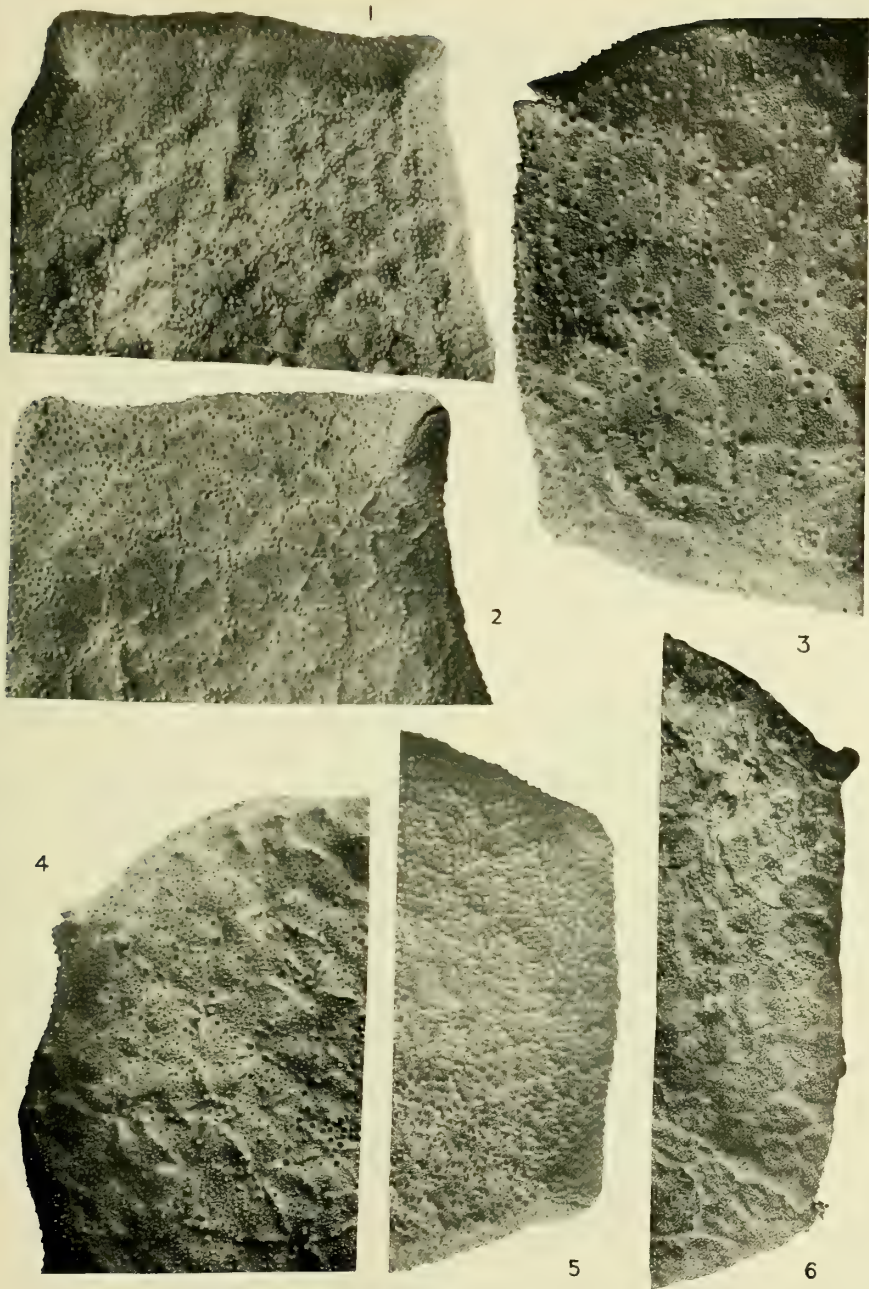


NEW SPECIES OF *DRYOPIDAE*.

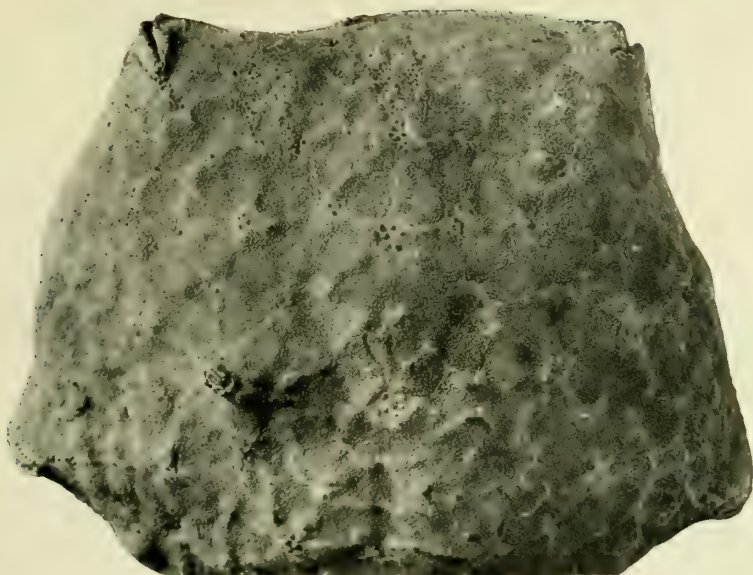


AUSTRALIAN LANCELETS AND LAMPREYS.

G. P. Whitley, del.



REPRESENTATIVES OF THE ASTEROID GENUS *CULCITA*.



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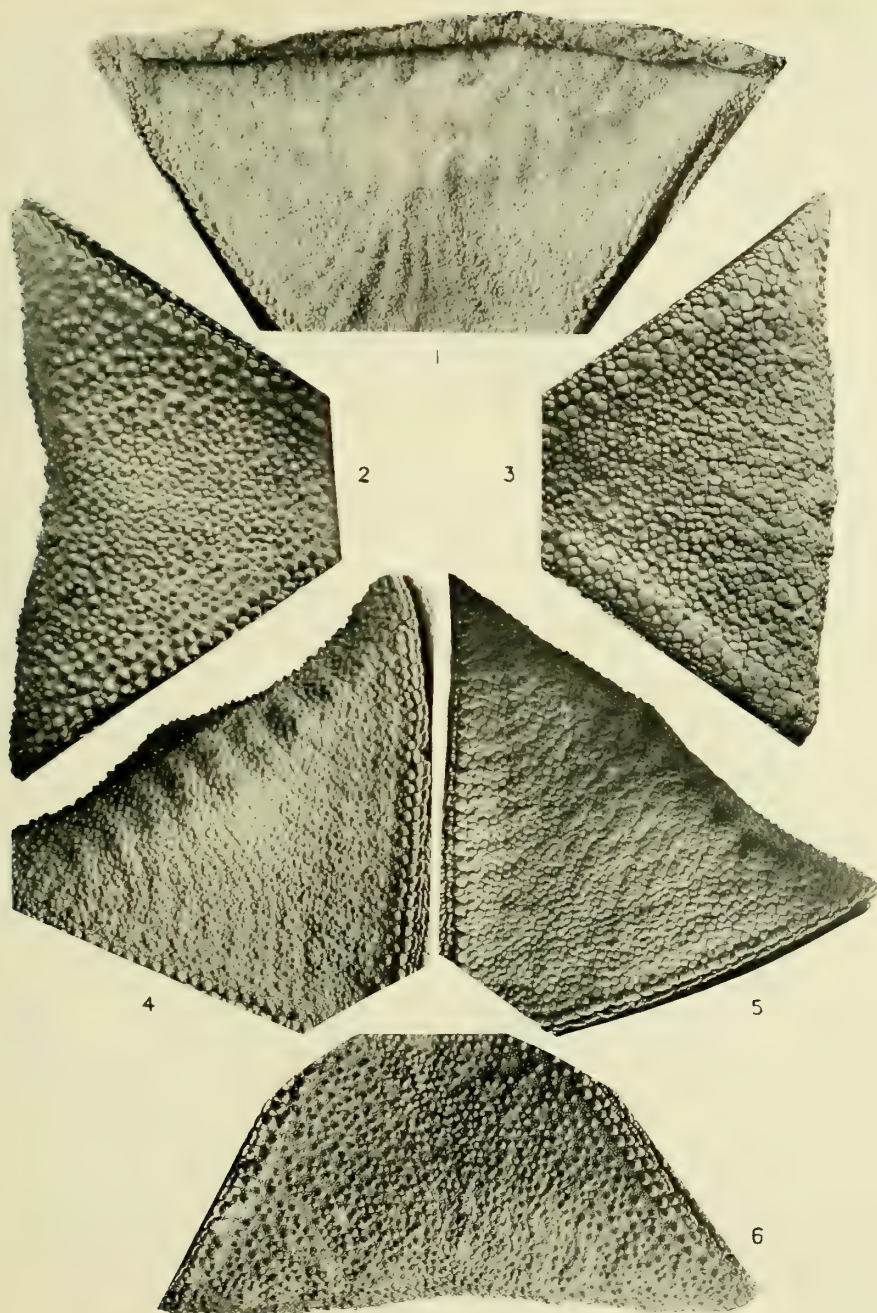


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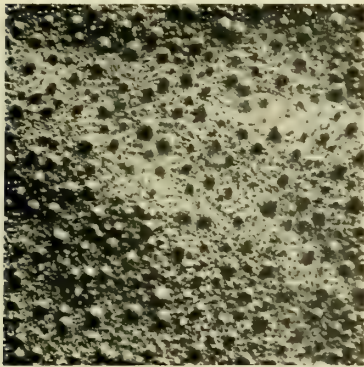


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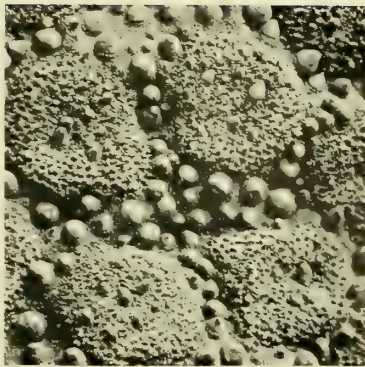
REPRESENTATIVES OF THE ASTEROID GENUS *CULCITA*.



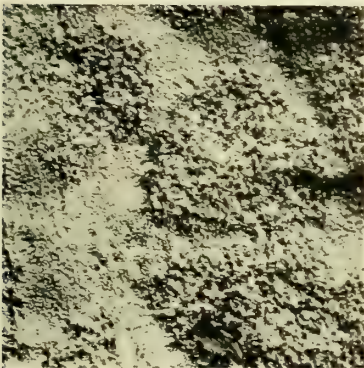
REPRESENTATIVES OF THE ASTEROID GENUS *CULCITA*.



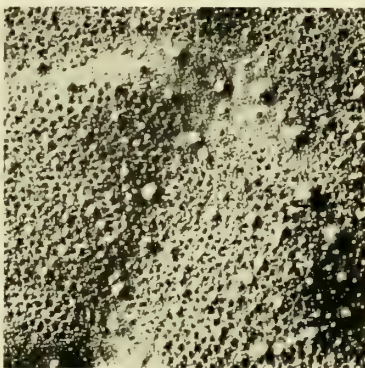
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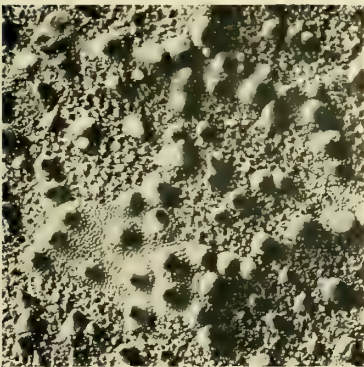
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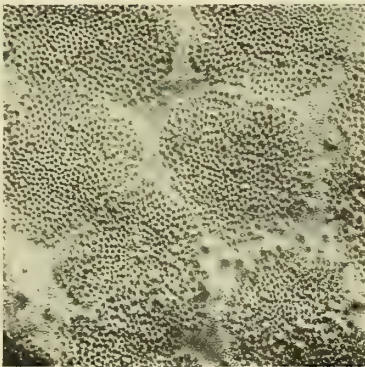
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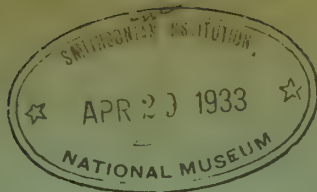


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REPRESENTATIVES OF THE ASTEROID GENUS *CULCITA*.



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Royal Zoological Society of New South Wales

New Meeting Room.

On 1st February, 1933, the Society moved from the first floor to the ground floor of Bull's Chambers, 28 Martin Place, Sydney. The new room is much larger than the one previously occupied, and it is now possible to accommodate up to 75 members at any meeting.

New Members.

The following have been elected since the publication of the last list (15th September, 1932):—Ordinary Members.—A. A. Atkinson, A. F. Barker, W. Barrie, H. J. Bernard, A. T. Bolton, A. Burton, V. Duclos, S. Dummett, Miss E. M. Hayes, H. W. Ireland, Miss Macanish, W. E. Mitchell, K. Montgomery, A. E. Nichols, C. D. Paterson, Mrs. H. E. Peir, H. D. Preston, N. L. Roberts, J. D. Sutton, J. D. Tipper, E. Tomkins, S. V. Toose, A. J. Turkington, and Mrs. C. Q. Williams. Associate Members.—H. B. Atkinson, A. J. Bearup, Miss G. W. Barker, A. H. Brain, R. W. Bush, K. J. Clinton, H. F. C. Davis, J. Forward, Miss B. French, D. Frost, W. P. Griffin, A. R. Hammill, J. L. Hattersley, Mrs. E. Hurt, G. W. James, E. H. Johnston, Miss G. Kennedy, M. Kent, F. C. Kitchen, G. Lewers, P. Murphy, F. D. McCarthy, Rev. E. N. McKie, R. McRowan, T. J. McSwiggan, G. S. Nock, H. Paul, W. L. Penny, J. Phelps, H. W. Pocock, W. Relton, Miss D. Risby, Miss E. Sanderson, F. W. Sands, J. F. Scott, J. Shaw, Dr. C. D. Sherborn, F. Shoults, A. E. J. Thackway, T. Webster, Mrs. T. Webster, A. Whiteley, and E. F. Wilks.

New Honorary Associate.

Dr. Charles Davies Sherborn, compiler of the monumental "*Index Animalium*," recently completed, has been elected an honorary associate member of the Society, in recognition of his distinguished services to Australian zoology.

Mr. A. H. Chisholm.

In consequence of his appointment to the staff of the Melbourne "Argus" and "Australasian," in succession to the late Mr. Donald Macdonald, Mr. A. H. Chisholm has resigned from the Council of this Society. Members of Council met on the 25th February, and tendered him a cordial farewell, coupled with good wishes for success in his new field. Appreciative references were made to his valuable work in placing before the public several popular works dealing with the birds of Australia, and particularly those of coastal New South Wales and Queensland. His keen and always constructive criticism of the work of the Society, together with his close observation of the habits and excellent photographs of our birds have done much to further the objects of the Society.

Election of Councillor.

Dr. E. A. D'Ombain has been elected to fill the vacancy in the Council caused by the resignation of Mr. A. H. Chisholm. Dr. D'Ombain was first elected a member of Council in 1918. He resigned in November, 1930, and has recently recovered from the result of an accident. His return to the Council was received with cordial appreciation.

APR 23 1933

Fellows Qualification Committee.

The rule governing the election of Fellows of the Society has been amended by the omission, in section 2, of the words "the President, and Honorary Secretary, *ex officio*, together with two other members of the Council," and the insertion of the words "those members of Council who are Fellows." The effect of this amendment is that the Qualification Committee now consists of those Fellows who are members of Council, who have power to co-opt another zoologist.

Election of Fellow.

In recognition to his distinguished services to Australian zoology, and particularly the compilation of his "Bibliography of Australian Entomology," Mr. Anthony Musgrave, F.E.S., has been elected a Fellow of the Society.

Appointment of London Agent.

Wheldon & Wesley, Ltd., has been appointed London agent of the Society, and the firm will supply the Society's publications to applicants residing in Great Britain or Europe.

EXHIBITION OF CAGE BIRDS.

The Avicultural Section of the Society held its first exhibition of Cage Birds on February 15th, 16th and 17th. Messrs. Farmer & Co., Ltd., very generously made their spacious Blaxland Galleries available for the purpose, and the great floor space was tastefully laid out with tables. A central aviary contained a series of interesting colour variations of the Budgerigar, while miniature aquaria were placed here and there, pleasantly breaking the sequence of cages. Lounges were available at convenient places, and the walls and ceiling were decorated in lavish colouring, so that the whole atmosphere was harmoniously composed for the display of birds.

The Exhibition was opened by the Lord Mayor, Alderman R. C. Hagon, in the presence of a large gathering. Particular reference was made by the Lord Mayor to the growing interest in Aviculture, and to the delightful field it opened up for intelligent observation and the study of our native birds. The Hon. Frank Chaffey, Chief Secretary, moved a vote of thanks to the Lord Mayor for officiating. Mr. Chaffey remarked that our fauna held a high place in the affections of the people. It was his duty to hold the balance between the man on the land, who was fighting for a living and those who desired protection for birds and animals, regardless of the damage which they may cause to our primary producer. Colonel Spain, President of Taronga Park Trust, seconded the motion, which was carried with enthusiasm.

The President of the Society, Mr. Neville Cayley, moved a vote of thanks to Messrs. Farmer & Co., for placing their Blaxland Galleries at the disposal of the Society. Mr. Wright acknowledged the compliment.

At the conclusion of the formal speeches, an inspection of the exhibits revealed some wonderful results which have been attained by colour selection in the breeding of Budgerigars. More than twenty distinct colours were on exhibition in a series of classes, which included green, yellow, light blue, cobalt, mauve, olive suffused white, grey wings, with many beautiful body colours. Outstanding amongst them was a team of yellowish olives ringed with cinnamon, and grey-wing jade greens and blues. More than

300 Budgerigars were on exhibition, altogether an amazing series, which might well inspire the aviculturist to extend his experiments to other of our birds, particularly the broad tails (*Platyercus*), there is much promise in such an undertaking. Many exhibits could not successfully compete, as much has yet to be done to correctly classify new colours or combinations which are constantly being produced.

Parrots were well represented, both Australian and foreign, the small *Agapornis* of East Africa in five species, the Nyassa, the Fisher, the Black Cheeked, the Peach faced, and an outstanding bird, the Yellow Collared or Masked Love bird, tried to attract attention, whilst a sulphur crested Cockatoo talked insistently and danced before an admiring throng. In the near distance a red and blue Macaw screeched defiance at opposition and would not be silenced until a Bopal nut was given him to crack. This task accomplished, the glorious monarch of the parrot world yielded to the fondling of his admirers. He was in splendid condition.

Other parrots claimed considerable attention, delightfully tame, they lived up to their reputation as the monkeys of the bird world.

Some delightful Whydahs and Weavers were on show, a giant Whydah claiming special attention. Lesser Finches of outstanding merit were the violet eared Waxbill and Melba Finches from Africa, two Buntings and the tiny blue breasted Waxbill. The Rice Finch or White Java Sparrow in different stages of development gained many admirers; there are few birds which show themselves so perfectly. A special prize, valued at £3/3/-, donated by the President for the best display of birds was won by the Messrs. A. & E. Hargreaves. Prizes, valued each at £1/1/-, donated by Dr. Garnet Halloran, were won by W. Hollingsworth, for the most successful exhibit of Australian Finches, and by C. Springall for Foreign Finches. Mr. A. L. Turner donated seeds and undertook the feeding of the whole of the birds whilst on exhibition, and so well was this done that no losses were reported. The judging was in the hands of Messrs. Peir, Mackie, Buckle, Cayley and Coles.

Splendid service was rendered by the executive; outstanding workers in addition were Messrs. Hargreaves, French, Mackie and Reg. Jones. The exhibition sets a new standard for shows of this nature, and an insistent demand is heard that the Society should regard the affair as an annual fixture.

SYLLABUS OF SECTIONAL MEETINGS, MARCH TO JUNE, 1933.

Avicultural Section.

(Second Monday in the month.)

- 13th March.—"Australian Finches," by Neville W. Cayley.
 10th April.—"Birds of North Australia," by Price Conigrave
 8th May.—"Rambles in Birdland," by K. A. Hindwood.
 12th June.—"Some Australian Birds," by Clifford Coles.

Budgerigar Club.

(Third Tuesday in the month.)

- 21st March.—"Management of Budgerigars," Ernest W. Jones.
 18th April.—"My Experiences," E. Hargreaves.
 16th May.—"The Great and Small in Aviaries," Charles Camp.
 20th June.—"The Why and Wherefore of Breeding Budgerigars," by H. E. Peir.

(An open discussion follows each talk.)

Marine Zoological Section.

(First Monday in the month.)

6th March.—"Marine Mammals," by E. L. Troughton.

3rd April.—"Crabs," by Mel. Ward.

1st May.—"Fisheries," by A. N. Colefax.

7th June (Tuesday).—Presidential Address by G. P. Whitley.

Ornithological Section.

(Third Friday in the month.)

17th March.—"Islands and Birds," by A. F. Basset Hull.

21st April.—"Wild Animals in Africa," by E. J. Bryce.

19th May.—"Reminiscences of a Birdman," by Clifford Coles.

16th June.—"Birds and Mangroves," by K. A. Hindwood.

REVIEWS.

WHAT BUTTERFLY IS THAT?—By G. A. Waterhouse, D.Sc., F.E.S. (Sydney, Angus & Robertson, Ltd.). 1932. (12/6).

When Lord Chelmsford was Governor of New South Wales he performed the ceremony of opening a new wing of the Australian Museum, and on this occasion he referred to the want of cheap handbooks to the butterflies, birds, and other native fauna of Australia, attributing the dearth of Australian boy collectors to this want. Taking this public utterance as a text, the Royal Zoological Society endeavoured to establish a Handbook Fund. It had amongst its members men capable of writing and illustrating the required books, but after fifteen years of endeavour the Society has only been able to accumulate £1,000, whereas at least £5,000 would be required as a capital fund to provide income sufficient to produce at most one book per annum. That enterprising firm, Angus and Robertson, of Sydney, has stepped into the arena, and has published this, the second handbook, to fill the want emphasised by Lord Chelmsford. The first work, Neville Cayley's 'What Bird is That?,' recently reviewed in this journal, was written and illustrated by a member of this Society. The second, 'What Butterfly is That?,' is also written by a member of this Society, and illustrated by Neville Cayley. Dr. Waterhouse is known as the "Butterfly Man" of Australia. His monumental work on the Butterflies of Australia, written some years ago in collaboration with George Lyell, is too highly technical and expensive to be regarded as a "Handbook," but it established his reputation in the field of Entomology. His recent donation of his magnificent collection of Australian butterflies to the Australian Museum has established his claim to be regarded as a public benefactor, and the work under review has earned for him the gratitude of every person who delights in collecting and preserving our beautiful butterflies.

Opening with a disquisition on the position of the butterfly in nature, the author proceeds to describe in general terms the life-history of the Lepidoptera or scale-winged insects. This is followed by a short note on classification, both of these introductory sections being couched in popular language, scientific terms being used only where absolutely necessary. The main part of the work deals with each family in detail, and the scientific name is followed by the popular or vernacular name. The egg, larva, pupa, and imago, or perfect butterfly, are each described in respect of each family. The families are again divided into genera, and the genera into species. Where known, the life-history of the species, its food plant, distribution, etc., are given, and it is surprising how few species have yet to be supplied

with these details. Of course, the coloured plates are of wonderful assistance to the student, and a delight to even the casual observer. Very many are of natural size, and all are remarkably clear in detail of marking and brilliancy of colouring; Mr. Cayley's work in this respect being even superior to his bird plates. A most useful chapter on "Collecting" provides the field naturalist with every direction necessary to enable him to successfully capture and preserve his specimens. In every way this work is an ideal realisation of a collector's handbook, and author, artist, and publishers are to be congratulated upon its production.

—A. F. B. H.

BIBLIOGRAPHY OF AUSTRALIAN ENTOMOLOGY, 1775-1930. With Biographical Notes on Authors and Collectors. By Anthony Musgrave, F.E.S., Royal Zoological Society of New South Wales, Sydney. Published 16th September, 1932. Quarto, pp. viii. + 380. Price, 10/-; postage extra.

Every modern specialist must at times be appalled by the amount of "literature" dealing with his subject and sigh, in the words of the preacher, in *Ecclesiastes*, "Of making many books there is no end; and much study is a weariness of the flesh." One kind of book which is welcome, however, is the carefully compiled bibliography which acts as a key to unlock the store of accumulated records, the study of which is imperative before original research can be performed. Such a key, so far as Australian entomological writings are concerned, is provided by Mr. A. Musgrave's Bibliography, a work foreshadowed in his Presidential Address, *The History of Australian Entomological Research*, delivered to our Society in 1930.

The objects of this Bibliography are to list all papers and books touching on Australian Entomology which have appeared between 1775 (when Fabricius described the insects from Cook's voyage) to 1930; to give information about the authors and collectors themselves; to record the scientific expeditions which have visited Australia; and to summarise the principal entomological collections and types in our Museums.

The scope of this work is thus a very broad one, but the ground has been remarkably well covered, especially as pains have been taken to verify practically all references. The modern entomologist who seeks type localities, original descriptions of genera and species, or exact dates of publication, and abstracts of old or rare books, will find this work invaluable. It is too little to say that this Bibliography should be on every entomologist's book-shelf, where dust and silverfish may corrupt; it should be taken down from the shelf and used daily. A subject index gives a handy guide to the vast store of papers listed, and there is a section on Australian Fossil Insects. The library technique suggested in the Introduction, would, if followed by describers of new genera and species, result in the avoidance of preoccupied names and other errors.

As a contribution to Australiana, this Bibliography is of great value as the routes of old voyages, and much hitherto unpublished biographical data are included. Captain James Cook and later British and foreign explorers are fully dealt with as regards the entomological results from their voyages. In a work of this magnitude it is inevitable that errors creep in or omissions are made, but these are relatively few, and, to quote David Starr Jordan, "We must not expect a degree of accuracy which the subject in question does not permit." It may, however, be pointed out that the death of Dr. H. W. Horn, reported in Musgrave's Bibliography, is somewhat exaggerated, as Mark Twain might have said, as that eminent entomologist is happily still alive. This Bibliography is of convenient size and has been excellently printed by the Australasian Medical Publishing Company, Ltd., Sydney.

—GILBERT P. WHITLEY.

"AUSTRALIAN FINCHES IN BUSH AND AVIARY."—By Neville W. Cayley, Sydney. Angus & Robertson, Ltd., 1932. Price, 12/6.

Mr. Cayley, President of the Royal Zoological Society of N.S.W., adds another interesting book to our growing list of Australian productions.

The author breaks new ground, giving us a book primarily as an aid to bird-keeping—a hobby so much in evidence all over the world, and of which our beloved King is a recent recruit.

Aviculture is greatly aided by this new arrival, the author giving us breeding results from many local aviaries, which are full of information touching upon the subject of feeding, care and management, in sickness and in health. The building and furnishing of aviaries is well handled, photographs help the general purpose. Of outstanding merit are the reproductions in colour of all of our known varieties and hybrids in ten plates, and numerous half tone plates which enable the beginner to identify any Finch at a glance, and add greatly to the usefulness and attraction of the work.

Interesting information is furnished as to the habits of the birds in the bush, their known breeding seasons, and the types of nesting sites, nests, eggs, and the hybrids which have been definitely identified, the result of much close searching for accurate detail.

The introduction might have given us a word or two on the place our Finches take in the great order of Fringillidae and, to quote Newton, "of the greater or less affinity anyone of them might bear to the rest." We are too prone to accept our Ploceidae or Weavers as Finches, without argument. On this subject there is room for enlightenment. It is sadly missing in the book under review.

The work reflects great credit on the author, blockmaker, printer, and publishers.—C. C.

WATER LIFE.—By Charles Barrett, in collaboration with Tom Iredale (Conchologist) and Gilbert P. Whitley (Ichthyologist), Australian Museum, Sydney. *Sun Nature Book*, No. 4, quarto, pp. 44, 7 col., plates and numerous illustrations in black and white. (Published by The Sun News-Pictorial, Melbourne, February 6th, 1933.) Price sixpence.

The fourth of the "Sun" Nature Books is, perhaps, the most useful of the series, since it places before the Australian public information upon groups of animals which have hitherto escaped popular treatment.

Mr. Barrett has been particularly fortunate in enlisting the aid of such well-known authorities as Messrs. Iredale and Whitley, and their names set a seal upon the work. Under the headings of The Fishes of Australia, Australian Sporting Fishes, The Coral Pool, The Story of the Seals, Australian Shells, Australian Kingfishers, is given a mine of information set forth in a manner which should have an appeal to all interested in the animal life of stream or ocean.

The illustrations call for very favourable comment, the coloured plates, one by Miss Joyce K. Allan, and others by Miss Ethel A. King, are very well-produced, and the remainder of the pictures, based on photographs or drawings from scientific publications, should prove useful aids in the identification of the animals.

As no work of a similar nature exists in Australia, "Water Life" should prove immensely popular with fishermen, school-teachers and children, and all those who find pleasure in Nature, and the extremely modest price of sixpence brings it within the reach of all.

—A. M.

THE BEES OF AUSTRALIA.

By T. D. A. COCKERELL.

(Continued from vol. vii., part iii., p. 218.)

HALICTUS Latreille.

The genus *Halictus* is found in every part of the world where bees exist, except in the far north, where the only bees are *Bombus*, and on certain groups of islands, as the Hawaiian Islands. It is rather easily distinguished by the venation of the wings, the marginal cell being pointed (not blunt as in *Nomia*), and the basal nervure strongly arched or bent. The species are excessively numerous, and often difficult to describe or identify. Thus the details of the sculpture, which afford excellent specific characters, are hard to express clearly in words. Australia is exceedingly rich in *Halictus*, and undoubtedly many remain to be described. The student is recommended to gather together as much material as possible, and then construct tables to separate all the species, regardless of their names. When this is done, the more evident characters of the various forms will be familiar, and then it will be much easier to use the literature. The tables given below, and the short accounts in the list of species, will usually not suffice for certain identification, but they will make it possible to exclude most of the species from the possibility of being identical with the one in hand. The Australian museums contain identified specimens of many of the species, including numerous types.

A paper in *Annals and Magazine of Natural History*, September, 1904, contains a table of F. Smith's species, so far as represented in the British Museum. Three Tasmanian species are lacking; they are separable thus:—

- | | |
|---|-----------------------------|
| Nervures fuscous, antennae black, middle tergites white-tomentose at base | <i>familiaris</i> (Erichs.) |
| Nervures pale testaceous | 1. |
| 1. Female; margins of tergites narrowly rufopiceous | <i>orbatus</i> Sm. |
| Male; disc of thorax aeneous; flagellum fulvous beneath; apex of clypeus yellow | <i>cognatus</i> Sm. |
| (Probably male of <i>H. globosus</i> Sm.) | |

The above was compiled from the descriptions, but *H. orbatus* has since been recognised, and is given in the tables below.

In 1902 Robertson proposed the generic names *Chlorelictus* and *Evyllaues* for *Halictus* of rather small size, without hair-bands on the apical margins of the tergites, and with the outer recurrent and intercubital nervures perceptibly weakened. These have been accepted as valid subgenera in America, but they occur equally in the Old World, and may be observed in Australia.

The subgenus *Pachyhalictus* Cockerell was proposed in 1929 for the "Halicti nomiiformes" of Vachal and Blüthgen. The female is stout, with peculiar sculpture, and the male has short antennae. The typical species are Asiatic, but the Australian *H. stirlingi* Ckll. and *H. maitlandi* Ckll. belong to the same group.

A peculiar Australian group is typified by *H. macrops* Ckll. It is robust, with a very broad abdomen, although a male. A female of the same group has been described as *H. barretti* Ckll. (Amer. Museum Novitates, No. 346, p. 14); it has just the same sort of abdomen. Under the microscope the mesothorax of *H. macrops* shows sparse strong punctures on a non-sculp-

tured surface, while *H. barretti* shows weaker punctures on a minutely lineolate surface. *H. barretti* is from Victoria, *H. macrops* from Tasmania.

The species described by Friese are discussed in Amer. Museum Novitates, 343 (1929). The species collected by F. X. Williams in Queensland, and now in the Museum of Comparative Zoology, Harvard University, are described or recorded in Psyche, xxxvii., No. 2 (1930). Fourteen new forms, the types in the Queensland Museum, are described in Mem. Queensland Museum, x. (August, 1930). Eight species, belonging to the Australian Museum, are described or recorded in Records Australian Museum, xvii., No. 5 (1929).

The Australian species of *Halictus* are all confined to Australia. Vachal recorded *H. urbanus baudinensis* Ckll. from New Caledonia, but I am confident that this was an error. The species I obtained in New Caledonia (*H. polygoni* Ckll., *H. risbeci* Ckll., and *H. crotalariae* Ckll.) are all endemic.

Thorax at least partly metallic, blue or green.

- | | | |
|---|-----|--|
| Abdomen wholly or partly red | 1. | (first tergite red in <i>limatiformis scrupulosus</i> Ckll.) |
| Abdomen not red | 15. | |
| 1. Mesothorax with large coarse punctures | | <i>punctatus</i> Sm. |
| (Mesothorax dull blue-green; see <i>brisbanensis</i> Ckll.) | | |
| Mesothorax with fine punctures | 2. | |
| 2. Abdomen very dark, practically black in middle, reddened at base and apex; femora black, with knees red | | <i>tatei</i> Ckll. |
| Abdomen not thus dark | 3. | |
| 3. Base of abdomen red | 4. | |
| Base of abdomen black (green in <i>vitripennis</i>), or with a very large black mark | 8. | |
| 4. Stigma pale testaceous | 5. | |
| Stigma brown or dark | 7. | |
| 5. Femora mainly black | | <i>vitripennis</i> Sm. |
| (Pale reddish stigma and dark femora, but mesothorax much darker, blue-green, and not polished) | | <i>tarltoni</i> Ckll.) |
| Legs, including femora, pale clear red | 6. | |
| 6. Mesothorax somewhat shining | | <i>eyrei</i> Ckll. |
| Mesothorax shining bright emerald green; stigma dilute sepia | | <i>dotatus</i> Ckll. |
| 7. Stigma very dark | | <i>tatei</i> Ckll. |
| (Stigma dark reddish brown; head and thorax yellowish green, metathorax blue; apical third of abdomen infuscated; male) | | <i>sphecodopsis</i> Ckll.) |
| Stigma large, reddish, not dark | | <i>tarltoni</i> Ckll. |
| 8. Base of abdomen green | | <i>vitripennis</i> Sm. |
| Base of abdomen black or with a large black mark | 9. | |
| 9. At least tibiae and tarsi clear red | 10. | |
| Legs dark | 11. | |
| 10. Male; the shining mesothorax practically black, with very little metallic colour | | <i>tasmaniae</i> Ckll. |
| 11. Stigma very dark | 12. | |
| Stigma light reddish to pale testaceous | 13. | |
| 12. Mesothorax shining blue | | <i>oxoniellus</i> Ckll. |
| Mesothorax dull blue-green (indications of large shallow punctures) | | <i>brisbanensis</i> Ckll., var. a. |
| 13. (All have black metathorax, and abdomen red at end.) | | |

- Abdomen with large black spots at extreme sides; mesothorax blue-green *raymenti* Ckll.
 Abdomen without such lateral spots 14.
14. Mesothorax green *erythrurus* Ckll.
 Mesothorax small, dark blue *erythrurus atrocyaneus* Ckll.
15. Males 16.
 Females 21.
16. Clypeus without a light mark; very small species 17.
 (Not very small, see *flindersi* Ckll.)
 Clypeus with a light band or mark 18.
17. Area of metathorax blue, scutellum green *kesteveni* Ckll.
 (See also *hilli* Ckll., about 6 mm. long.)
 Area of metathorax green, scutellum brassy *hackeriellus* Ckll.
 (Mesothorax brassy, see *microchalceus* Ckll.)
 (Near to *kesteveni*, hind tibiae and tarsi red, stigma dark *williamsi* Ckll.)
18. Head very large; mandibles yellow; flagellum light orange-ferruginous beneath *purnongensis* Ckll.
 Head ordinary 19.
19. Middle and hind tibiae red *dampieri* Ckll.
 Middle and hind tibiae mainly black 20.
20. Abdomen black *cognatus* Sm.
 Abdomen brownish-black, hind margins of tergites discolored; flagellum red *haematostoma* Ckll.
 Abdomen shining green *veronicae* Ckll.
21. Abdomen black or dark brown 22.
 Abdomen blue or green 36.
22. Legs clear red, including femora *eyrei darwiniensis* Ckll.
 (Tibiae and tarsi red *williamsi* Ckll.)
 At least the femora dark 23.
23. Abdomen more or less pruinose-hairy, and hind margins of tergites discolored 24.
 Abdomen shining black, hind margins of tergites not discoloured 30.
24. Mesothorax brilliant peacock green; tibiae clear red
 *urbanus* Sm. (see also v. *baudiniensis* Ckll.)
 Mesothorax not so coloured 25.
25. (Mesothorax polished; flagellum bright red; male. *haematostoma* Ckll.)
 Mesothorax not polished 26.
26. (All have flagellum red beneath; it is dark brown beneath in *williamsi* Ckll.)
 Tegulae large, testaceous, colourless anteriorly; mesothorax dull and dark 27.
 Tegulae ordinary, small, darker 28.
27. Smaller; mesothorax dark blue; stigma pale testaceous . *inclinans* Sm.
 Larger; mesothorax dark green; abdomen may be slightly metallic *subinclinans* Ckll.
 (Mesothorax yellowish green, stigma dark *williamsi* Ckll.)
 (Close to *williamsi*, but mesothorax more shining, scutellum shining *suburbanus* Ckll.)
28. (Mesothorax rather bright green; abdomen distinctly metallic *holochlorus* Ckll.)
 Larger; mesothorax dark blue or greenish blue *subinclinans* Ckll.

- Smaller; mesothorax dark green 29.
29. Abdomen with dark red tegumentary bands *rufotinctus* Ckll.
 Abdomen without such bands *mundulus* Ckll.
 (Area of metathorax with conspicuous shining margin; first recurrent
 nervure going to basal corner of third cubital cell . *luctificus* Ckll.)
30. Mesothorax polished 31.
 Mesothorax with a dull surface 32.
31. Larger *demissus* Ckll.
 Smaller *demissus* Ckll., var.
 (Like *demissus*, but mesothorax a little duller, and area of metathorax
 quite different *limatiformis* Ckll.)
32. Mesothorax not brightly coloured 33.
 Mesothorax very brightly coloured, blue or green 34.
33. Larger; abdomen red at apex *saycei* Ckll.
 Much smaller; metathoracic area blue *kesteveni* Ckll.
 (Metathorax black; mesothorax dark blue *dorsicyaneus* Ckll.)
 (Very small; mesothorax brassy green; hind tibiae red at base and
 apex; abdomen faintly submetallic; male . . *microchalcus* Ckll.)
34. Mesothorax peacock blue *murrayi* Ckll.
 Mesothorax green 35.
35. More strongly bluish green
 *urbanus* Sm. (see also var. *stradbrokensis* Ckll.)
 (*H. urbanus* from Sydney is larger and appears different from the
 others. The type locality is Champion Bay, W.A.)
 (Mesothorax duller, etc. *suburbanus* Ckll.)
36. Mesothorax shining blue *flindersi* Ckll. (typical.)
 Mesothorax rich dark blue, with dull surface 37.
 Mesothorax green 38.
37. Stigma very dark, abbreviated apically *pavonellus* Ckll.
 Stigma very pale testaceous, of usual shape *floralis* Sm.
38. (Extremely small, with brassy mesothorax and dark stigma; male . .
 *microchalcus* Ckll.)
 Not extremely small, etc. 39.
39. Tibiae and tarsi red, or tibiae partly darkened 40.
 At least tibiae dark 43.
40. Mesothorax with a dull surface 41.
 Mesothorax shining 42.
41. Stigma pale testaceous *floralis* Sm.
 Stigma dark brownish *subcarus* Ckll.
42. Mesothorax peacock green, approaching blue . . *behri transvolans* Ckll.
 Mesothorax olive green *flindersi thor* Ckll.
 (Related, but larger, with olive green instead of bluish abdomen . .
 *luteoaneus* Friese.)
43. Area of metathorax with strong coarse rugae 44.
 Area of metathorax finely sculptured 47.
44. (All have dark stigma.)
 Mesothorax with oblique striae 45.
 Mesothorax without oblique striae 46.
45. Mesothorax yellow green *caloundrensis* Ckll.
 Mesothorax blue green *caloundrensis leucurus* Ckll.
46. Head broader *flindersi* Ckll.
 Head narrower; scape red at base *woodsi* Ckll.

47. Abdomen feebly metallic; hind margins of tergites reddened; stigma light rufotestaceous *holochlorus* Ckll.
 Abdomen strongly metallic 48.
 48. Area of metathorax very long, very minutely sculptured . *dampieri* Ckll.
 Area crescentic, ordinary 49.
 49. Clypeus very short, dark purplish *victoriae* Ckll.
 Clypeus much longer, brilliant green
 *callaspis* Ckll (stigma amber colour.)

The following supplementary tables of metallic species will further facilitate determination:—

- (1.) Abdomen green; tibiae and tarsi light ferruginous; male
 *dampieri* Ckll.
 Abdomen black 1.
 1. Small species, with red (or mainly red) tibiae;
 females 2.
 Larger species, with dark tibiae 3.
 2. Green of thorax very bright
 *urbanus* Sm. (see also *murrayi* Ckll., legs black.)
 Green of thorax obscure; stigma very pale yellowish
 *mundulus* Ckll.
 (See also *williamsi* Ckll., stigma dark, mesothorax dull yellowish green.)
 3. Mesothorax shining, sparsely punctured *demissus* Ckll.
 Mesothorax dull, much more closely punctured
 *subinclinans* Ckll.
 (*subinclinans* has flagellum fulvous beneath; mesothorax much
 duller than in male *cognatus*.)
 (2.) Abdomen red 1.
 Abdomen not red 3.
 1. Abdomen red at base Tasmanian species; specimen
 without head.
 Abdomen black at base 2.
 2. Mesothorax blue; stigma piceous *oxoniellus* Ckll.
 Mesothorax olive green (Brisbane specimens) or obscure brassy
 (Yallingup specimens); stigma yellowish, not dark
 *erythrurus* Ckll.
 3. Abdomen shining black *urbanus* Sm.
 Abdomen metallic 4.
 4. Larger; abdomen purple blue *caloundrensis leucurus* Ckll.
 (first regarded as a variety of *H. flindersi*.)
 (Very close to *H. behri transvolans*; differs by dark tibiae and
 tarsi, and angular tubercles. The dark legs and mandibles
 also distinguish it from true *H. behri*. It differs from *H.*
flindersi by the light hair of caudal fimbria.)
 Smaller; abdomen dull green; male with long black antennae . .
 *dampieri* Ckll.
 (*H. hackeriellus* differs from *dampieri* by being smaller;
 scutellum brassy, contrasting with metathorax; antennae
 shorter.)

Thorax black, not metallic.

(In *H. rowlandi* Ckll. the thorax is rufofulvous. In *H. ruficollis* Friese
 it is largely red.)

- Abdomen red, wholly or in part 1.

- (*H. niveorufus* Friese, female 10-11 mm. long, has red abdomen.)
- Abdomen not red 7.
1. Scutellum and postscutellum densely covered with fulvous tomentum; abdomen black with two broad red bands; female . . . *doddi* Ckll.
Scutellum and postscutellum not so covered 2.
 2. Abdomen entirely red from base to apex, at most (*H. clarigaster*) somewhat dusky on apical half 3.
Abdomen not entirely red 4.
 3. Mesothorax very coarsely punctured; tibiae and tarsi pale red . . .
. *ewarti* Ckll.
Mesothorax very finely punctured; tibiae and tarsi mainly dark . . .
. *clarigaster* Ckll.
(*H. blandulus* Ckll., from King George's Sound, has the abdomen entirely red.)
 4. Abdomen red with shining black base; very small female
. *basilucens* Ckll.
Abdomen darkened or black apically 5.
 5. Abdomen very broad, dull red, dark brown at base and apex; female *cyclurus* Ckll.
(Abdomen with broad red bands *mesembryanthemi* Ckll.)
Abdomen narrow; males 6.
 6. Red almost confined to second tergite; stigma dark brown
. *hedleyi* Ckll., var. a.
Red much more extensive; stigma light reddish with a dark margin . .
. *tasmaniae* Ckll.
(Male with abdomen largely red *disclusus* Ckll.)
(*H. rufibasis* Ckll. has abdomen beyond base of third tergite black.)
 7. First tergite with a strong median carina; abdomen with white hair-spots; female *mirandus* Ckll.
(*H. alboguttatus* Friese has white spots at sides of tergites 2 to 4.)
Without such characters 8.
 8. Males 9.
(See also *clelandi* Ckll., *warburtoni* Ckll., *waterhousei* Ckll., and *isthmalis* Ckll.)
Females 35.
 9. Tegument of clypeus entirely black 10.
Clypeus with a light mark 12.
(Male 8 to 9 mm.; clypeus yellowish-white apically. *obscuripes* Friese.)
 10. Tegulae black; face broad; supraclypeal area very prominent; clypeus is a little pallid apically, when looked at from below
. *bursariae* Ckll.
Tegulae rufous; face covered with white hair 11.
 11. Area of metathorax entirely dull; larger species
. *clariventris* Friese (my specimen lacks abdomen.)
Area of metathorax with a shining rim; very minute species
. *niveifrons* Ckll.
(Very small; extreme edge of clypeus hardly noticeably pallid; first recurrent nervure joins third cubital cell . . . *micridoneus* Ckll.)
Very broad face and abdomen; aspect of a female . . . *macrops* Ckll.
(A related female is *H. barretti* Ckll.)
(Allied, with long antennae *H. euryurus* Ckll.)
 12. Head extremely large and broad, broader than thorax; clypeal yellow with a median upward extension; legs mainly red

- *pachycephalus* Ckll.
 Head more ordinary 13.
 13. Flagellum of antennae clear red beneath 14.
 (Flagellum clear red beneath, last three joints black; a small
 species *picticornis* Ckll.)
 Antennae dark 15.
 14. Extremely minute; anterior tibiae and tarsi light red .. *forticornis* Ckll.
 Larger; anterior tibiae black; abdomen broad; basitarsi creamy
 white *victoriellus* Ckll.
 (The male *H. mesembryanthemi* Ckll., with white basitarsi, is hardly
 different.)
 (*H. clariventris* Friese differs from *H. victoriellus* by the broader, very
 dull mesothorax, all black tegument of clypeus, and dense white
 hair on face.)
 15. Large; anterior wing 7.8 mm.; second cubital cell very broad; legs
 black *leucorhinus* Ckll.
 (*H. lanarius* Sm. has anterior wing 6.4 mm.)
 Much smaller 16.
 16. Hind tibiae and tarsi red 17.
 At least hind tibiae dark 22.
 17. Hind margins of tergites pallid *lei* Ckll.
 Hind margins of tergites not pallid 18.
 18. Abdominal tergites, at least the second, with laterobasal hair-
 patches *dolichocerus* Ckll.
 Abdomen without such patches 19.
 19. Larger; mesothorax very highly polished on disc; labrum yellow
 *mirandus* Ckll.
 Smaller (*H. bicingulatus* may be large); mesothorax dullish, or shining
 posteriorly; labrum not yellow 20.
 20. Tegulae piceous, with a red spot; scutellum highly polished; area of
 metathorax large, entirely dull *sanguinipes* Ckll.
 Tegulae clear rufofulvous 21.
 21. Apical part of wings strongly dusky; stigma more pointed
 *haematopus* Ckll.
 Wings not thus darkened; stigma more obtuse *bicingulatus* Smith.
 (These two are very close, but appear distinct.)
 22. Stigma dark; all tarsi pale red *blackburni* Ckll.
 (If tarsi pale (not red), and stigma dark, see *forresti* Ckll., which is
 much larger.)
 (With dusky stigma, and very slender dull red tarsi .. *plebeius* Ckll.)
 Stigma not dark, or if so, tarsi not pale red 23.
 23. Area of metathorax very coarsely sculptured; tarsi whitish
 *forresti* Ckll.
 Area not thus coarsely sculptured 24.
 24. Abdomen very broad; hair bands (interrupted in middle) at bases of
 second and third tergites; face covered with white hair; stigma
 light reddish *expansifrons* Ckll.
 Abdomen otherwise, though sometimes broad 25.
 25. At least hind basitarsi black or dark brown (dark dusky red in *H.*
bursariae) 26.
 Tarsi pallid or reddish 28.
 26. Smaller; abdomen broad, hairy, hind margins of tergites paler;
 mesothorax polished *cambagei* Ckll.

- (See here also *H. pulvitectus* Ckll. (clypeal band cream colour), *H. viridarii* Ckll. (mesothorax dull), and *H. sculpturatus* Ckll. (smallish; abdomen shiny black, not hairy).)
- Larger; abdomen black, robust, but not specially broad 27.
27. Clypeal mark lemon yellow; abdomen dull, with very broad shining hind margins of tergites *kurandensis* Ckll.
Clypeal mark cream colour; abdomen shining all over; the abdomen much more robust than that of *lanariellus*, and stigma darker *spenceri* Ckll.
Clypeal mark small, whitish; abdomen hairy *lanarius* Smith.
Clypeal mark whitish, small; abdomen narrower than in *lanarius*, less distinctly punctured, and not so hairy *lanariellus* Ckll.
(*H. excusus* Ckll. runs to *lanariellus*, but differs by the entirely dull mesothorax; *H. subplebeius* Ckll. is small; abdomen shining black, not hairy; hind tarsi very dark reddish.)
28. Hind margins of second and third tergites narrowly but conspicuously red; tarsi clear red; stigma pallid; clypeal mark whitish *idoneus* Ckll.
Hind margins not thus red 29.
29. Excessively small, with pale labrum and partly cream-coloured mandibles; head large for size of insect *cyclognathus* Ckll.
(Face much narrower *micridoneus* Ckll.)
Larger; mandibles different 30.
30. Anterior tibiae clear red in front; area of metathorax with a shining rim *repertulus* Ckll.
(If tibiae partly pale in front, area without shining rim, see *idoneus* Ckll.)
Anterior tibiae not clear red in front 31.
31. Stigma pallid, with dark margin; area appears without shining rim, but seen from behind, shows a shining margin *idoneus* Ckll.
(Much smaller *micridoneus* Ckll.)
Stigma with solid colour, dark or reddish 32.
32. End of abdomen with a bright red rounded plate; face broad *repertus* Ckll.
(Compare *H. isthmalis* and *H. cambagei*; the former has red tibiae, in the latter neither tibiae nor tarsi are red; *repertus* has red tarsi.)
End of abdomen without such a plate 33.
33. Mesothorax dull *blackburni* Ckll.
Mesothorax shining 34.
34. Light mark on clypeus very obscure; supraclypeal area forming a flattened, highly polished plate *bursariae* Ckll.
Clypeus with a very distinct mark; supraclypeal area not peculiar; smaller species *plebeius* Ckll.
(Tarsi very dark reddish *subplebeius* Ckll.)
35. Postscutellum and sides of pronotum densely covered with yellow or reddish tomentum; large species *musicus* Ckll.
(*H. waterhousei* Ckll. is allied.)
Not thus ornamented 36.
36. Large or rather large species, the abdomen with red or fulvous bands 37.
37. Smaller species, or abdomen without such bands 40.
37. Postscutellum not covered with tomentum, but a cuneiform mark of

- fulvous tomentum at each side of prothorax above; scape dark ..
 *tertius* Dalla Torre.
 Postscutellum with a patch of dense tomentum 38.
38. Scape bright red; bands of orange tomentum at bases of second and
 third tergites, sometimes hidden when abdomen is contracted ..
 *peraustralis* Ckll.
 Scape black 39.
39. Hind margins of tergites red *leai* Ckll.
 Hind margins of tergites not or slightly red *bicingulatus* Smith.
40. Scutellum and postscutellum densely covered with pale fulvous
 tomentum *paracolletinus* Ckll.
 Scutellum not so covered 41.
41. Postscutellum densely covered with fulvous tomentum; area of meta-
 thorax dull, with raised lines (subgenus *Pachyhalictus*)
 *stirlingi* Ckll.
 (Another *Pachyhalictus* is *H. maitlandi* Ckll., postscutellum densely
 covered, area of metathorax without raised lines.)
 (Postscutellum covered; tibiae and tarsi clear red; large species
 *moreensis* Ckll.)
 Otherwise 42.
42. Very minute species, with at least tibiae and tarsi clear
 red 43.
 Otherwise; legs not so coloured 44.
43. Femora entirely red *eurhodopus* Ckll.
 Femora black, red at apex *cassiaeifloris* Ckll.
44. Hind margins of first three tergites broadly clear red
 *mesembryanthemi* Ckll.
 (Margins more or less pallid in the larger *H. helichrysi* Ckll., var., and
 in *H. pulvitectus* Ckll.)
 Hind margins not thus red 45.
45. Abdomen black, without any traces of bands 46.
 Abdomen with hair bands or tomentum at bases of tergites, sometimes
 thin; or delicate pruinosity, and hind margins more or less
 pallid 50.
 (The abdomen is brown in *Parasphecodes bribiensis* Ckll.; it is greenish,
 with the hind margins of tergites brown, in the New Zealand *H.*
smithii Dalla Torre.)
46. Comparatively large and robust, length 9 mm.; area of metathorax
 without plicae; hind tibiae with much black hair *dauidis* Ckll.
 (Aspect of *H. dauidis*, but smaller, with darker wings, and area finely
 plicate *franki* Friese.)
 Much smaller 47.
47. Area of metathorax large, appearing roughened, but microscope shows
 delicate wavy plicae; mesothorax dullish *blackburni* Ckll.
 (*H. semipolitus* Ckll. might be looked for here, but mesothorax shining.)
 Area with plicae readily visible under a lens 48.
48. Mesothorax shining, practically impunctate *sturti* Ckll.
 Mesothorax conspicuously punctured 49.
49. Area of metathorax very long; wings very brown *imitans* Ckll.
 (Larger and more robust, with much shorter area *franki* Friese.)
 Area short; wings clear hyaline (Port Darwin) *nigropolitus* Ckll.
50. Larger species, of build of *H. lanarius* 51.
 Smaller or small species 58.

51. Abdomen very hairy, especially on third and fourth tergites; area of metathorax very finely sculptured *lanarius* Smith.
(A variety with black tegulae occurs at Tooloom, N.S.W.)
(Very similar, but smaller, with much more finely punctured mesothorax *instabilis* Ckll., var. a.)
Abdomen not thus hairy 52.
52. Area of metathorax large, dull, not plicate . . . *instabilis* Ckll., type.
(Area very feebly plicate.
Abdomen broad, dullish, hind margins of tergites subrufescent *instabilis* Ckll., var. a.)
Abdomen narrower, shining pure black *semitens* Ckll.)
Area distinctly plicatulate 53.
53. Basal bands of abdomen pure white, narrowed or broken
in middle 54.
Basal bands of tergites greyish, broad and continuous on third and fourth 56.
54. Area of metathorax strongly shining, plicate, concave, not pointed behind *circumdatus* Ckll.
Area dull 55.
55. Area very large, delicately sculptured all over, little concave *asperithorax* Ckll. (var. ?)
(Allied but smaller, with narrower, shining abdomen. *semitens* Ckll.)
Area of metathorax short, concave, moderately pointed behind; wings brownish *littleri* Ckll.
56. Tegulae pure black; mesothorax posteriorly with large punctures on a shining ground *eboracensis* Ckll.
Tegulae dark reddish; area pointed behind 57.
57. Larger; mesothorax dull, with coarse punctures *seductus* Ckll.
Smaller; mesothorax shining, with small punctures *repraesentans* Smith.
(Differing by area not at all pointed behind *lanariellus* Ckll.)
(Area large and dull, not at all pointed behind . . . *instabilis* Ckll. var. a.)
(With clear white bands of tomentum at bases of second and third tergites *griseovittatus* Ckll. var.)
58. Tergite 4 with fine thin pruinose pubescence all over 59.
Tergite 4 not thus covered 61.
59. Smaller; area of metathorax shining at sides; mesothorax shining *plebeius* Ckll.
(Small, with flagellum bright red beneath *picticornis* Ckll.)
Larger; area wholly dull 60.
60. Mesothorax dull *granulithorax* Ckll.
(Allied is *H. willsi* Ckll., but second cubital cell different.)
(Very near *H. granulithorax*, but smaller; first tergite more shining; scutellum dull except on anterior margin *clariventris* Friese.)
(The first tergite is excessively densely punctured all over in *granulithorax*, but minutely transversely lineolate in *clariventris*.)
Mesothorax shining, but closely punctured *pulvitetus* Ckll.
(Area of metathorax large, glistening, finely sculptured all over *imitans* Ckll.)
61. Hind tarsi red; small species with reddened wings . . . *speculellus* Ckll.
(Larger, with shining black abdomen *exceptus* Ckll.)
Hind tarsi not red, or if dusky reddish, much larger
species 62.

62. Small species, 5.5 to 6.5 mm. long 63.
Larger, and usually more robust 66.
63. Tegulae pale testaceous; mesothorax highly polished; second cubital cell broad; outer intercubitus and recurrent nervures hardly visible; the microscope shows the metathoracic area minutely reticulate *mediopolitus* Ckll.
Tegulae rufous to rufopiceous 64.
64. Face not conspicuously hairy 65.
(Male; face very broad, conspicuously white-hairy; second cubital cell very narrow; microscope shows area with vermiform rugae all over *macrops* Ckll.)
65. Tegulae red *semipolitus* Ckll.
Tegulae practically black *semipolitus expulsus* Ckll.
(The microscope shows that *semipolitus* has the metathoracic area with strongly wrinkled rugae on basal half. In *expulsus* the area is finely reticulate on basal half, and beyond that minutely tessellate; also the second cubital cell is narrower, especially above.)
(Compare also *H. victoriellus* Ckll. and *H. helichrysi* Ckll.)
66. Tegulae clear rufous; mesothorax dull; second cubital cell broad 67.
Mesothorax shining, or tegulae very dark 70.
67. (In *H. opacicollis* and *H. instabilis* var. b. the tegulae are darker than in the others.)
Wings reddish 68.
Wings not at all reddish 69.
68. Larger; abdomen very broad, with a very broad band of pale grey tomentum at base of third tergite *instabilis* Ckll., var. b.
Smaller; abdomen not so broad, and basal band of third tergite hidden in middle; area of metathorax very large, with very fine longitudinal plicae, between them finely tessellate *opacicollis* Ckll.
69. Sides of mesothorax posteriorly with areas of large punctures on a shining ground; area of metathorax with very fine irregular plicae all over, and microscopically tessellate between the plicae *orbatus* Smith.
Mesothorax dull all over; area of metathorax large, minutely reticulate, at sides with straight plicae *granulithorax* Ckll.
70. Second and third tergites with hind margin narrowly rufous or pallid 71.
Second and third tergites with margin black, or with a broad dark reddish suffusion 73.
71. Flagellum bright chestnut red beneath; area of metathorax with very fine wrinkled plicae all over *helichrysi* Ckll.
(What I recorded from Bribie Island as *helichrysi*, var., was *pulvitectus*.)
Flagellum much darker 72.
72. Wings reddish; area of metathorax with fine rugae all over, having little projections at sides, as in *H. imitans* *pulvitectus* Ckll.
Wings not reddish; area of metathorax with fine wrinkled rugae, producing a reticulation; scutellum finely and densely punctured *victoriellus* Ckll.
(The last three are very closely allied; possibly to be considered races of one species.)

- (Allied to *victoriellus*, but smaller, and first tergite smooth *barretti* Ckll.)
73. Scutellum large, dullish, not bigibbous; abdomen very broad; area of metathorax with fine weak plicae on basal half only, no cross striae on apical middle *instabilis* Ckll. (type.)
(Var. a. has cross-striae on apical middle of area.)
- Scutellum polished, often more or less bigibbous 74.
74. Area of metathorax with a conspicuous shining rim 75.
Area without such a shining rim 76.
75. Hair-band of fourth tergite extremely broad, covering all of tergite except depressed portion; area of metathorax with very fine irregular plicae all over *lanariellus* Ckll.
Hair band of fourth tergite narrow, basal; area of metathorax with very fine wrinkled rugae, producing a reticulation *supralucens* Ckll.
76. Fourth tergite pruinose-pubescent all over; area of metathorax with fine distinct plicae, having little projections at sides in *pulvitectus* style; scutellum well punctured *imitans* Ckll.
Fourth tergite not pubescent all over 77.
77. Basal bands of tergites 2 and 3 in good specimens broad and very conspicuous; area of metathorax with very fine wrinkled rugae, forming a fine reticulation, but not reaching apical margin; scutellum densely punctured; second cubital cell broad, receiving recurrent nervure at apical corner *griseovittatus* Ckll.
Basal bands not thus conspicuous 78.
78. Mesothorax well punctured; area of metathorax shorter and well plicate as seen under lens, the microscope shows fine vermiform rugae, failing apically, and straight plicae at sides *confusellus* Ckll.
(Mesothorax dull, very coarsely punctured *evasus* Ckll.)
Area of metathorax much larger, with finer sculpture, very fine plicae, only regular on basal part *seminitens* Ckll.
(Hind tarsi dark red; wings quite dark *exceptus* Ckll.)

Supplementary tables of black *Halictus*.

Table 1. (Males.)

- Lower margin of clypeus not yellow; aspect of a female. *macrops* Ckll.
Lower margin of clypeus yellow 1.
1. Very small, less than 5 mm. long; tarsi yellow *forticornis* Ckll.
Larger, at least over 5 mm. 2.
2. Tarsi black *spenceri* Ckll. and *lanarius* Sm.
Tarsi red or yellow 3.
3. Stigma ferruginous; head broad and massive *pachycephalus* Ckll.
Stigma fuscous 4.
4. Small species; antennae not especially long *blackburni* Ckll.
Larger; antennae very long 5.
5. Mesothorax shining *dolichocerus* Ckll.
Mesothorax dull *haematopus* Ckll.

Table 2. (Males.)

- Clypeus all dark 1.
Clypeus with a light marginal band 3.
1. Antennae rather short; face very hairy *niveifrons* Ckll.
Antennae very long 2.

2. Mesothorax dull *blighi* Ckll.
Mesothorax shining (one specimen has only two cubital cells) *bassi* Ckll.
3. Very minute; mesothorax very shiny . . . *cyclognathus* Ckll., var. a.
Medium size (if tegulae amber and tibiae red . . . *haematopus* Ckll). 4.
4. Smaller; tarsi red or reddish . . . *isthmalis* Ckll. and *pulvitectus* Ckll.
Larger; tarsi dark *baudini* Ckll. and *boweni* Ckll.

Table 3. (Males; the clypeus with a light apical band.)

- Femora red; abdomen without pale hair-bands or patches *bicingulatus* Sm.
Femora not red 1.
1. Larger; hind basitarsi dark brown *kurandensis* Ckll.
Smaller; hind basitarsi clear ferruginous or yellowish 2.
 2. Mesothorax rough, the dense punctures visible under a lens *idoneus* Ckll.
Mesothorax dull, not rough, the punctures not evident under a lens *blackburni* Ckll.

Table 4. (Females; comparatively large species.)

- Mesothorax finely punctured 1.
Mesothorax coarsely punctured or rugose 2.
1. Area of metathorax strongly striate, pointed behind; sides of middle of mesothorax sparsely punctured *repraesentans* Sm.
Area finely rugulose, striate at sides, not at all pointed behind *instabilis* Ckll.
 2. Mesothorax rugose as well as punctured; area of metathorax strongly striate, pointed behind; abdomen shining *seductus* Ckll.
Area of metathorax not pointed behind 3.
 3. Smaller; disc of scutellum with extremely fine regular punctures, and a very few larger ones; front dull *orbatus* Sm.
Larger; disc of scutellum with more irregular punctures, and conspicuous larger ones; front shining between the punctures *lanarius* Sm.

Table 5. (Females; *H. bicingulatus* group.)

- Disc of mesothorax glaucous, with sparse punctures; scape piceous; abdominal bands orange *tertius* Dalla Torre.
Disc of mesothorax dull, minutely granular; scape red *peraustralis* Ckll.
Disc of mesothorax finely (very densely) punctured; scape black *bicingulatus* Sm.
(Hind margins of tergites ferruginous *lei* Ckll.)

Table 6. (Females.)

- Small species with extremely shiny mesothorax and scutellum; basal hair bands of abdomen very dense, broad laterally *mediopolitus* Ckll.
Not so 1.
1. Large species, with area of metathorax strongly striate or plicate, and truncation very strongly obliquely striate or plicate. 2.
Not so 3.
 2. Apical part of area of metathorax dull *repraesentans* Sm.

- Apical part of area very shiny *circumdatu*s Ckll.
3. Mesothorax very strongly punctured; tegulae rufotestaceous; scutellum with very minute punctures and scattered larger ones *orbatus* Sm.
Mesothorax not so strongly punctured 4.
4. Mesothorax with a dull sericeous surface; scutellum shining; area of metathorax very large; wings brownish *opacicollis* Ckll.
Mesothorax excessively densely punctured *granulithorax* Ckll.
(Very like *H. willsi* Ckll.; second cubital cell differently shaped.)
Not thus 5.
5. Larger, more robust; postscutellum large, almost angulate behind *instabilis* Ckll., var. b.
Smaller and otherwise *victoriellus* Ckll. and *imitans* Ckll.

Table 7. (Females; small or smallish species of Queensland.)

- Femora clear red; small species *eurhodopus* Ckll.
Femora dark, with little if any red 1.
1. Tibiae clear red; small species *cassiae*floris Ckll.
Tibiae dark 2.
2. Abdomen without hair-bands or spots; mesothorax not closely and distinctly punctured 3.
Abdomen more or less hairy; mesothorax closely and distinctly punctured 4.
3. Mesothorax shining *sturti* Ckll.
Mesothorax dull, it and the scutellum very faintly greenish *blackburni* Ckll.
4. Hind margins of tergites black; broad basal bands of white tomentum *griseovittatus* Ckll.
Hind margins of tergites reddened; abdomen hoary, but no basal bands of tomentum *helichrysi* Ckll.

LIST OF SPECIES OF HALICTUS.

Those marked (M.) have at least some metallic (blue or green) colour.

Halictus alboguttatus Friese.

Central Australia. Judging from the description, this seems to be a synonym of *H. conspicuus* Sm. Length 8 mm., with white hair-spots at sides of tergites 2 to 4. It was collected by von Müller.

Halictus asperithorax Cockerell.

Melbourne (C. French); type in British Museum. Also at Sandringham, V. Female about 8 mm. long; black, dorsal hair dull pale ochreous. Related to *H. chapmani* Ckll.

Halictus barretti Cockerell.

Seaforth, V. (W. F. Hill). Allied to *H. macrops* Ckll. Female about 5.5 mm.; black, with very broad abdomen.

Halictus basilucens Cockerell.

Bribie Island (Hacker); type in Queensland Museum. Female hardly 5 mm. long; abdomen bright castaneous, the first tergite black, polished, except the broad apical margin. Differs from *H. cyclurus* by the distinct rugae of area of metathorax.

Halictus bassi Cockerell.

Mount Wellington, Tasmania (R. Turner). Type in British Museum. Male about 5.5 mm. long. A variation (var. a.) has only two cubital cells. Disc of mesothorax shining between punctures (dull in *H. blighi*). Keys

to separate this and other black Tasmanian *Halictus* are given in Ann. Mag. Nat. Hist., August, 1915, pp. 100, 101.

Halictus baudini Cockerell.

Mount Wellington, Tasmania (R. Turner). Type in British Museum. Male about 7 mm. long; black; larger than *H. repertus*, with a quite different area of metathorax.

Halictus behri Cockerell (M.)

Port Darwin, N.T. (Turner). Type in British Museum. Female, length 6.5 mm.; close to *H. flindersi*, but mesothorax brilliant blue, and there are differences in sculpture.

Halictus behri transvolans Cockerell (M.)

Mackay, Q. (Turner). Type in British Museum. Female with mesothorax peacock-green; abdomen shining dark green. Resembles *H. flindersi* in ventral scopa on abdomen, and the transverse lineolation in front of anterior ocellus, but with ferruginous (more or less infuscated) tibiae and tarsi.

Halictus bicingulatus Smith.

Melbourne, V., to Mackay, Q. Type in British Museum. Legs dusky red; bases of second and third tergites with broad bands of orange tomentum.

Halictus bicingulatus leai (Cockerell).

Victoria (French) to Brisbane, Q. Type in British Museum. Described as a distinct species, but better regarded as a variety or race of *bicingulatus*. The male is described in Proc. Acad. Nat. Sci. Philadelphia, 1913, p. 32. For a discussion of this group see Ann. Mag. Nat. Hist., May, 1914, p. 508. Female nearly 9 mm. long; scape black.

Halictus blackburni Cockerell.

Mackay, Q. (Turner). Type in British Museum. *H. crinitus* Friese is a synonym. Female about 6 mm. long; male much more slender. Superficially resembles *H. sturti*. The male has all the tarsi clear ferruginous; antennae only moderately long, dark.

Halictus blandulus Cockerell.

King George's Sound, W.A. Type in Australian Museum. Female nearly 6 mm. long, broad and robust; head and thorax black. Resembles *H. clarigaster* Ckll., but abdomen much broader and duller; known from *H. ewarti* Ckll. by the dull abdomen, colour of legs and sculpture of thorax. In the original description (Records Australian Museum, 1929) a line has been omitted.

Halictus blighi Cockerell.

Mount Wellington, Tasmania (Turner). Type in British Museum. Male about 6 mm. long; looks like *H. plebeius*, but antennae quite different (extremely long, black), dark clypeus, and dullish and sculptured scutellum.

Halictus boweni Cockerell.

Eaglehawk Neck, Tasmania (Turner). Type in British Museum. Male a little over 6 mm. long, very like *H. baudini*, but anterior and middle tibiae light red in front, abdomen much narrower, stigma darker, etc.

Halictus brazieri Cockerell.

Yallingup, W.A. (Turner). Type in British Museum. Female (not male, as given in original description) about 11 mm. long; resembling *Parasphcodes noachinus*, and connecting *Halictus* with *Parasphcodes*.

Halictus bremerensis Rayment (M.)

W. Australia. Female about 5 mm. long; resembles *H. demissus* Ckll. (Jn. Roy. Soc. W. Australia, xvii., p. 171).

Halictus brisbanensis Cockerell (M.)

Brisbane, Q. (Hacker). Female about 5 mm. long; head and thorax black, with the mesothorax dull blue-green; abdomen shining chestnut-red, hind margins of first three tergites with broad black bands, not reaching extreme sides; stigma large and dark; legs largely red. Varies to forms with much darker abdomen, and the mesothorax may be yellowish green. Allied to *H. sphecodoides* Sm.

Halictus burkei Cockerell.

Hobart, Tasmania (J. J. Walker). Type in British Museum. Female about 5 mm. long; black, with the abdomen rufo-piceous; mesothorax very shiny; tegulae pale testaceous, with a dark mark in front; stigma very large, dull reddish-brown. The abdomen beneath has much white hair, used for collecting pollen.

Halictus bursariae Cockerell.

Brisbane, Q. (Hacker); also Caloundra and Queensland National Park. Male about 6 mm. long, shining black; antennae long, entirely dark. Belongs to a group which includes *H. cambagei*, *H. repertus*, *H. isthmalis* and *H. repertulus*. The dark tibiae distinguish it from *H. isthmalis*; the black tegulae from *H. repertulus*.

Halictus callaspis Cockerell (M.)

Bribie Island, Q. (Hacker). Female about 6.5 mm. long; mesothorax yellowish green, much brighter than head; scutellum peacock-green; abdomen shining olive-green. The amber-coloured stigma and very finely lineolate area of metathorax distinguish it from *H. flindersi*, *H. caloundrensis*, etc.

Halictus caloundrensis Cockerell (M.)

Caloundra, Q. (Hacker); also Bribie Island. Female 6 mm. long; of the group of *H. behri*, *transvolens* and *flindersi*, but easily separated by the mesothorax, which is very brilliant yellowish green, with transverse wave-like plicae, directed obliquely, so as to meet at an angle in middle line. Abdomen shining steel-blue, the venter with a curled white scopa. The form *leucurus*, described as a subspecies of *H. flindersi*, is nearer to *H. caloundrensis*.

Halictus cambagei Cockerell.

Adelaide, S.A. (Behr). Type in Berlin Museum. The male has the head very broad; sculpture of metathoracic area extremely fine (the area has evident ridges in *H. repertus* and *H. isthmalis*). Length about 5.5 mm.

Halictus cassiaefloris Cockerell.

Mackay, Q. (Turner). *H. tenuis* Friese is a synonym. Female about 5 mm. long; black, with dull white hair, not forming bands or spots on abdomen; mandibles clear red; scape clear red, the apical half above black or nearly; knees, tibiae and tarsi clear ferruginous. Allied to *H. eurhodopus*.

Halictus chapmani Cockerell.

Western Australia (Preiss). Type in Berlin Museum. Female about 7 mm. long. Very close to *H. repraesentans* Sm., but smaller. Abdomen shining, hind margins of tergites broadly very dark reddish; mesothorax shining. Rayment records it from Denmark, W.A., and notes that it is superficially similar to *H. victoriellus* Ckll.

Halictus circumdatus Cockerell.

Rutherglen, V. (French). Female about 8.5 mm. long; black, shining, with thin greyish-white hair; mesothorax shining, strongly, but not very densely punctured; basal area of metathorax concave, shining, strongly longitudinally plicate, sharp-edged, with the apical marginal area smooth and shining, depressed in middle; abdomen pure black, with clear white tomentum at bases of second to fourth tergites. Resembles *H. repaesentans*, but easily known from this and *H. seductus* by the area of metathorax.

Halictus clarigaster Cockerell.

Caloundra, Q. (Hacker). Female about 6.5 mm. long; head and thorax black; abdomen clear bright ferruginous, slightly dusky apically; labrum and mandibles dark red; tegulae light ferruginous; legs black, with all the knees, anterior tibiae in front, and the other tibiae on inner side, ferruginous. General aspect like *H. ewarti* Ckll.

Halictus clariventris Friese.

Adelaide, S.A. Female very like *H. granulithorax* Ckll., but considerably smaller, without the strong median sulcus on anterior part of mesothorax, while the first tergite is considerably more shining, and the scutellum is entirely dull except the anterior margin. The male resembles *H. victoriellus* Ckll., having a broad abdomen, like a female; the tegument of clypeus is all black.

Halictus clelandi Cockerell.

Adelaide, S.A. (Schomburgk). Type in Berlin Museum. Male about 6 mm. long; head and thorax black, abdomen and legs dark reddish brown; lower part of clypeus cream-colour, the actual margin ferruginous; mandibles ferruginous, dark at base; flagellum long, dark coffee-brown beneath.

Halictus cognatus Smith.

Launceston, Tasmania. Male with disc of thorax aeneous; flagellum fulvous beneath. Probably male of *H. globosus* Smith.

Halictus confusellus Cockerell.

Launceston, Tasmania (Littler). Female about 7 mm. long; separated from *H. imitans* by the ferruginous stigma and shorter area of metathorax; from *H. pulvitectus* by hind margins of tergites black.

Halictus conspicuus Smith.

"Australia." Female with tibiae and tarsi clear red; abdomen without bands, but with conspicuous patches of ochry-tinged white tomentum at lateral bases of tergites 2 to 4; tegulae fulvous; postscutellum transversely striate.

Halictus converus Smith.

Victoria. Female smaller and less hairy than *H. lanarius* Sm.

Halictus cyclognathus Cockerell.

Croydon, V. (S. W. Fulton). Eaglehawk Neck, Tasmania. Male not quite 4.5 mm. long; black, with scanty greyish-white hair; head very large and broad; cheeks broad and flattened, angled behind; mandibles long, strongly curved, cream-colour, red apically; clypeus with an apical pale band; abdomen short for a male, shining black. By the form of the head recalls *H. purnongensis*.

Halictus cyclurus Cockerell.

Mount Tambourine, Q. (Hacker). Female about 5.5 mm. long; head .

and thorax black; abdomen very broad and short, rather dark chestnut-red, the first tergite black except a marginal band; second with a transverse blackish band; fourth and following tergites fuscous. Allied to *H. hedleyi*.

Halictus dampieri Cockerell (M.)

Mackay, Q. (Turner). Type in British Museum. It extends from Brisbane to Cairns. *H. strangulatus* and *H. indigoteus* of Friese are synonyms; the latter the form with bluish-green mesothorax. The male is described in Trans. Amer. Ent. Soc., August, 1910, p. 228.

Halictus darwiniellus Cockerell.

Sydney, N.S.W. (Charles Darwin). Type in Hope Museum, Oxford. Belongs to subgenus *Evyllaenus*. Black; flagellum ferruginous beneath except basally; upper part of clypeus with a shining median groove; anterior wing 6.6 mm. long; second and third tergites with basal bands of white tomentum, failing in middle; fourth with a broad entire speckled band.

Halictus davidis Cockerell.

Kuranda, Q. (Turner). Type in British Museum *H. nigroscopaceus* Friese is a synonym. Female about 10 mm. long; abdomen shining black, without hair-bands or patches; resembles *Parasphecodes carbonarius* (Sm.), but less strongly punctured. Male about 8.5 mm. long; greater part of clypeus light yellow; flagellum very long. Pleura striated in both sexes.

Halictus demissus Cockerell (M.).

Launceston, Tasmania (Littler). Female nearly 5.5 mm. long; mesothorax shining green, polished; hind spur with four obtuse spines. Near *H. humilis*, but with dark legs and striate area of metathorax. Rayment (1930) has described the male, from Victoria.

Halictus disclusus Cockerell.

Eaglehawk Neck, Tasmania (R. E. Turner). Type in British Museum. Male about 6 mm. long, black, with the first three tergites bright chestnut red, but the first dark basally and with large dusky median cloud, second and third with a dark spot at each laterobasal corner; tegulae black. Resembles *H. tasmaniae* (Ckll.), but distinguished by the dull mesothorax.

Halictus doddi Cockerell.

Kuranda, Q. (Dodd). Female about 8 mm. long; rather slender, black, the first two tergites light ferruginous, with a large transverse black dorsal patch. This has a dorsal patch of dense tomentum in the manner of *H. leichardti*, from which it is easily known by the colour of abdomen. It approaches *Parasphecodes*, especially *P. basilautus* Ckll.

Halictus dolichocerus Cockerell.

Yarrowin, N.S.W. (Froggatt). Also at Brewarrina. Male 5 to 6 mm. long; antennae extremely long, dark; legs bright ferruginous, femora largely black, tibiae marked with black. The shining mesothorax at once separates it from *H. haematopus*.

Halictus dorsicyaneus Cockerell (M.).

Launceston, Tasmania (Littler). Female about 5 mm. long; mesothorax small, dark blue, shining, but not polished; scutellum blue, with two polished shining spaces; metathorax black; abdomen shining black. Differs from *H. kesteveni* Ckll. by the black (instead of blue) metathorax. Compared with *H. inclinans* Sm., it is less robust, with darker tegulae and different abdomen.

Halictus dotatus Cockerell (M.).

Sydney, N.S.W. (Froggatt). Also Tooloom. Female about 5.5 mm. long; head and thorax green, abdomen and legs bright ferruginous. Allied to *H. vitripennis*, but scape red and base of abdomen not black.

Halictus doweri Rayment (M.).

Mentioned in discussion of *H. occidentalis*. "May be near *vitripennis*."

Halictus eboracensis Cockerell.

Ebor, N.S.W. (A. J. Turner). Also at Barrington Tops. Black; the bases of tergites 3 and 4 with very broad bands of pale greyish tomentum, and base of second with a cuneiform patch of the same on each side. Allied to *H. seductus* Ckll., but mesothorax not dull anteriorly, and plications at base of metathorax not so fine. Male unknown.

Halictus elliotii Rayment.

E. Gippsland. Female 8.5 mm. long; allied to *H. lanarius* Sm. It appears blacker, being less hairy. Rayment figures the spurs. (Victorian Naturalist, October, 1929.).

Halictus erythrurus Cockerell (M.).

Croydon, V. (S. W. Fulton). Also Launceston, T.; York, W.A.; Brisbane, Q. Known from the similar *H. tarltoni* Ckll. and *H. raymenti* Ckll. by the highly polished clypeus. Rayment discusses the variation in Jour. Roy. Soc. W. Australia, xvii., p. 169. The female is a little less than 5 mm. long. The var. a. is rather smaller; mesothorax more shining, dark bluish green.

Halictus erythrurus atrocyaneus Cockerell (M.).

Brisbane, Q. (Hacker). Female about 4 mm. long; mesothorax very dark blue, thorax otherwise black; abdomen chestnut red, the first tergite black, except apically; mandibles red.

Halictus erythrurus maiusculus Rayment (M.).

Perth, W.A. Larger. Length, 5 to 6 mm.

Halictus etheridgei Cockerell.

Yallingup, W.A. (Turner). Type in British Museum. Female 9.5 mm. long; black, very robust; clypeus with a deep median sulcus; head extremely broad; wings dusky; no hair-bands or patches on abdomen.

Halictus eurhodopus Cockerell.

Kuranda, Q. (Turner). Female about 5 mm. long; rather slender, black, with the legs, except the coxae, bright clear ferruginous; abdomen with a narrow red apical plate, the venter with a curled white scopa. Allied to *H. cassiaeifloris*, but distinguished by the red femora.

Halictus euryurus Cockerell.

Adaminaby, N.S.W. (A. J. Turner). Type in Queensland Museum. Male nearly 6 mm. long; black, the abdomen broad-oval, the hind margins of the tergites beyond the first stramineous; tegument of clypeus entirely black. The metathorax (area with sharp straight plicae, only two or three in middle wrinkled) and antennae separate it at once from *H. macrops*. The mesothorax is much more coarsely punctured than in *H. clariventris* Friese.

Halictus evasus Cockerell.

Coolangatta, Q. (A. J. Turner). Type in Queensland Museum. Female 7 mm. long; black, head and thorax with rather long white hair, quite dense on cheeks and postscutellum; mesothorax dull, very coarsely punct-

tured; abdomen broad, shining. Very near to *H. confusellus* Ckll., but easily separated by the more robust dull, coarsely sculptured mesothorax, and the shining area of metathorax.

Halictus ewarti Cockerell.

Kuranda, Q. (Turner). Type in British Museum. Female nearly 7 mm. long; abdomen entirely bright chestnut red. It looks like a *Sphecodes*.

Halictus exceptus Cockerell.

Tooloom, N.S.W. (Hacker). Female about 7 mm. long; robust, black, including antennae; pubescence very scanty and short; mesothorax shining; abdomen shining black, with small white hair patches at sides of second and third tergites. Allied to *H. seminitens* Ckll., but easily distinguished by the rather pale reddish brown tarsi.

Halictus excusus Cockerell.

Pyengana, Tasmania (Littler). Male about 7.5 mm. long; slender, black, with a large triangular cream-coloured mark on clypeus (but labrum and mandibles black); antennae very long, flagellum moniliform, entirely black; abdomen densely and rather coarsely punctured. Separated from *H. lanariellus* Ckll., by the entirely dull mesothorax.

Halictus expansifrons Cockerell.

New South Wales. Male about 6 mm. long; black, robust (like a female); head broad; mandibles dark; clypeus with a transverse pale yellow band; antennae rather long, flagellum obscure reddish beneath; mesothorax shining, strongly punctured, sparsely in middle; tarsi cream-colour, becoming pale ferruginous apically. Closely allied to *H. clelandi* Ckll.

Halictus eyrei Cockerell (M.).

Mackay, Q. (Turner). Type in British Museum. Also at Brisbane and Caloundra. *H. claripes* Friese is a synonym. Female a little over 5 mm. long; abdomen entirely bright red.

Halictus eyrei darwiniensis Cockerell (M.).

Port Darwin, N.T. (Hill). Female with abdomen very dark brown, almost black, often with the base more or less red.

Halictus flindersi Cockerell (M.).

Mackay, Q. (Turner). Type in British Museum. Female about 6 mm. long; head, thorax and abdomen shining purple-blue, the upper part of clypeus and anterior part of mesothorax peacock-green. Male scarcely over 5 mm.; abdomen darker, little metallic. The female var. a. has mesothorax and scutellum entirely Prussian-green.

Halictus flindersi leucurus Cockerell (M.).

Bribie I., Q. (Hacker). This is better regarded as a variety of *H. caloundrensis* Ckll.; it has the hair at apex of abdomen entirely brownish white (dark fuscous in *H. flindersi*). See Ann. Mag. Nat. Hist., July, 1915, p. 7.

Halictus flindersi thor Cockerell (M.).

Thursday Island (Cockerell). Clypeus and supraclypeal area more or less coppery red, mesothorax and scutellum shining yellowish green; abdomen shining dark blue-green, the depressed portions of tergites more steel-blue; a large curled ventral scopa.

Halictus floralis Smith (M.).

H. vividus Smith the same. Female with abdomen green; mesothorax very bright green, but surface dull.

Halictus formosus Rayment (M.).

Albany, W.A. Female about 6 mm. long; allied to *H. callaspis* Ckll., and superficially resembles *H. demissus* Ckll.

Halictus forresti Cockerell.

Mackay, Q. (Turner). Type in British Museum. This is *H. scutellatus* Friese, male, but not female. The abdomen is very dark reddish, and the insect approaches *Parasphcodes*. Male about 6 mm. long; flagellum extremely long, black; mesothorax dullish; upper edge of prothorax, tubercles and postscutellum with white tomentum. In the original type the abdomen was entirely black; it seems to vary in colour.

Halictus forticornis Cockerell.

Kalamunda, W.A. (R. E. Turner). Type in British Museum. Male about 4 mm. long; very close to *H. cyclognathus*, but head smaller, antennae longer, and area of metathorax different. The flagellum is light orange-ferruginous beneath.

Halictus franki Friese.

Fremantle, W.A. Looks like *Parasphcodes plorator* Ckll., but area of metathorax quite different. Abdomen shining, broad and short, very finely and closely punctured, without hair-bands or spots; hind spur with short noduliform teeth. Wings distinctly dusky, with dark stigma; mesothorax excessively densely punctured all over.

Halictus furneauxi Cockerell.

Eaglehawk Neck, Tasmania (Turner). Type in British Museum. Female about 7 mm. long; superficially like *H. sturti*, but easily separated by the less shining mesothorax and more delicately sculptured area of metathorax.

Halictus gilesi Cockerell.

Victoria. Type in British Museum. Female about 8 mm. long, resembling *H. repraesentans*, but mesothorax much more coarsely sculptured. For microscopic characters, see Entomologist, 1905, p. 302.

Halictus glauerti Rayment (M.).

Perth, W.A. Female about 5 mm. long; very close to *H. vitripennis* Sm. (Jr. Roy. Soc. W. Australia, xvii., p. 170).

Halictus globosus Smith.

Tasmania. Female with mesothorax appearing black (Smith says with a brassy tinge); abdomen dark brown, tergites 3 to 5 pilose; outer intercubital and recurrent nervures almost obsolete.

Halictus granulithorax Cockerell.

Victoria (C. French). Female about 6.5 mm. long; black, robust, hind margins of tergites suffusedly reddish; tegulae fulvous. Very like *H. willsi* Ckll., but differs in venation and sculpture. It was taken by J. A. Kershaw at Pt. Lonsdale.

Halictus greavesi Rayment (M.).

Western Australia. Female 4.5 mm. long. Name misprinted *greavessi*. Abdomen and legs largely red; allied to *H. raymenti* Ckll.

Halictus griseovittatus Cockerell.

Brisbane, Q. (Hacker). *H. mjobergi* Friese, from Mt. Tambourine, is a synonym. Female about 7.5 mm. long; black, robust, with dull white hair; clypeus and supraclypeal area brilliantly shining, with large punctures; mesothorax shining, but strongly and quite closely punctured; bases of tergites with pale greyish tomentum. Looks rather like a small *H. repraesentans*, but metathorax quite different.

Halictus hackeriellus Cockerell (M.).

Brisbane, Q. (Hacker). Male about 5 mm. long; resembling *H. kest-eveni*, but head yellowish green; mesothorax and scutellum dull brassy, but the shining scutellum contrasting with the bluish green postscutellum and metathorax. Known from male *H. dampieri* by the smaller size, much shorter antennae, and absence of a yellow band on clypeus.

Halictus haematopus Cockerell.

Launceston, Tasmania (Littler). Male about 6 mm. long; resembles *H. sanguinipes* Ckll. and *H. bicingulatus* Sm. Flagellum wholly black; tegulae light orange-ferruginous; tibiae, tarsi and apical part of femora bright ferruginous; clypeus with a broad pale yellow band.

Halictus haematostoma Cockerell (M.).

Windsor, V. (French). Male about 4.75 mm. long; robust, with dull white hair; head and thorax black, with mesothorax and scutellum shining dark bluish green; flagellum bright apricot colour; labrum, mandibles (except base) and lower margin of clypeus bright ferruginous; wings clear; abdomen piceous, with hind margins of tergites pallid. Although a male, this has the build of a female, with robust body and short antennae. Related to *H. inclinans* Smith.

Halictus hedleyi Cockerell.

Port Philip, V. (Coulon). Type in Berlin Museum. Also at Cheltenham. Male about 5.5 mm. long; second and third tergites, and much of fourth, red; tegulae clear light reddish-testaceous; apex of abdomen with a broad plate as in *Sphecodes* subgenus *Proteraner*. The var. a. has the second abdominal tergite red, with a very broad dusky apical shade; the third red only at sides of base, fourth black.

Halictus helichrysi Cockerell.

Mt. Tambourine, Q. (Hacker). Also Brisbane and Bribie I. Female about 7 mm. long; black, the broad abdomen thinly hairy at sides and dorsally beyond middle, but not banded. Known from *H. victoriellus* and *H. plebeius* by the mesothorax strongly punctured, and hind margin of fourth tergite broadly whitish hyaline; from *H. imitans* by the flagellum red beneath.

Halictus hemichalceus Cockerell (M.).

Brisbane, Q. (Hacker). Type in Queensland Museum. Female about 5.5 mm. long; mesothorax and scutellum dark brassy green; abdomen dull ferruginous. A key separating this from others having mainly or wholly red abdomen is given in Ann. Mag. Nat. Hist., August, 1932, p. 240.

Halictus hilli Cockerell.

Port Darwin, N.T. (Hill). Male with head and thorax steel blue, scutellum with the polished disc olive green; head broad, eyes very strongly converging below; abdomen steel-blue, broadly reddened at bases of third and fourth tergites. Related to *H. caloundrensis* Ckll., but with lighter stigma and different coloration. There are transverse striae before the middle ocellus.

Halictus holochlorus Cockerell (M.).

Cheltenham, V. (French). Female a little over 6 mm. long; green, with dull white hair; known from *H. urbanus* by the light reddish stigma and green abdomen. It is larger than *H. floralis*. The legs are black or piceous, knees and small joints of tarsi more or less ferruginous; tegulae ferruginous.

Halictus humei Cockerell.

"Australia." Female about 5.5 mm. long; black, with greyish-white pubescence; flagellum brownish beneath; lateral bases of tergites 2 to 4 broadly covered with whitish tomentum. For microscopical character see Entomologist, 1905, p. 302. It nearly agrees with the brief description of *H. familiaris* (Erichs).

Halictus humiliformis Cockerell (M.).

Ebor, N.S.W. (A. J. Turner). Female resembling *H. limatiformis*, but mesothorax shining blue, with a polished surface. Differs from *H. humilis* by the black legs, with anterior knees red, and the entirely black antennae. The hind spur is not pectinate.

Halictus humilis Smith (M.).

Champion Bay, W.A. Female with mesothorax small and shining, dark green; abdomen shining black. See also Trans. Amer. Ent. Soc., August, 1910, p. 228.

Halictus idoneus Cockerell.

Brisbane, Q. (Hacker). Male about 7 mm. long; slender, black, with white hair; lower half of clypeus cream-colour, depressed in middle; flagellum long, entirely dark, very strongly crenulated beneath; legs black, with the tarsi, and extreme apices of tibiae, clear ferruginous. Known from *H. blackburni* by the rough mesothorax, the dense punctures visible under a lens.

Halictus imitans Cockerell.

Victoria (C. French). Type in British Museum. Also Georgetown, Tasmania. Female about 6.5 mm. long; black, robust; antennae entirely dark, the flagellum faintly brownish beneath; lateral bases of second and following tergites with rather inconspicuous patches of dull white tomentum; wings dusky.

Halictus inclinans Smith (M.).

Victoria and W. Australia. Female larger than *H. limatus* Sm.; mesothorax greener, dull; abdomen dark brown, with a sericeous surface. The type is from Champion Bay.

Halictus instabilis Cockerell.

Croydon, V. (Miss A. M. Fulton). Female about 8 mm. long; black, resembling *H. griseovittatus*, but larger, and the bands on abdomen slightly ochreous. The hind spur of hind tibiae in this and *griseovittatus* is of the same type, with a single stout oblique tooth a little before the middle, and beyond this a very long low lamina or keel. The variety a., with slightly reddish wings, and stigma clearer red, is from Windsor, V. Variety b., with longer postscutellum, subangulate behind; area of metathorax sharply defined, with stronger plicae; second cubital cell broad; is from Victoria.

Halictus isthmialis Cockerell.

Eaglehawk Neck, Tasmania (Turner). Type in British Museum. The male has the antennae long, black; a large broadly rounded red plate at end of abdomen. Length about 5 mm. The var. a. is smaller, with area of metathorax more finely sculptured, tegulae with a large red spot. It comes from Mt. Wellington. Smaller than *H. repertus*, with ridges of metathoracic area not limited to basal part, and tibiae red, as well as the tarsi. The female (about 6 mm. long) is described in Ann. Mag. Nat. Hist., August, 1915, p. 97.

Halictus kesteveni Cockerell (M.).

Kuranda, Q. (Turner). Type in British Museum. Goes north to Cape York. Male 4 to 4.5 mm. long; head and thorax dark green; metathorax blue; abdomen shining black, without bands; labrum and margin of clypeus dark. Resembles *H. saycei*.

Halictus kurandensis Cockerell.

Kuranda, Q. (Turner). Male about 6.5 mm. long; rather robust, black, with dull white hair; apical half of clypeus (narrowing laterally, not reaching sides) bright lemon yellow, but the actual margin light ferruginous; flagellum very long (about 4 mm.), strongly crenulate beneath; abdomen shining, without hair-hands. Resembles *H. circumdatus* by the striated pleura, and *H. tertius* by the glaucous mesothorax.

Halictus lanariellus Cockerell.

Yarrowin, N.S.W. (Froggatt). Also Kewell and Middle Harbour. Described from the female, but the male is described in Records Australian Museum, xvii., p. 229. Female about 8 mm. long. For characters see key.

Halictus lanarius Smith.

Widely distributed, from Devonport, Tasmania to Brisbane and Mt. Tambourine, Q., and as far as Halifax. Also at Adelaide, S.A. *H. lanuginosus* Smith is the same species. The male type (*lanuginosus*) has the clypeus with a yellowish white band; face with much white hair; whole insect very hairy. This may have to be called *H. infimus* (Erichson). Erichson's species, described (1841) under *Andrena*, cannot be precisely recognised from the description. See Trans. Amer. Ent. Soc., August, 1910, p. 236.

Halictus leichardti Cockerell.

Mackay, Q. (Turner). Type in British Museum. Also Kuranda and Dunk I. *H. paracoletinus* Cockerell and *H. scutellatus* Friese are synonyms. Wings with a strong fuscous tint. For diagnostic characters, see table. For male, see Ann. Mag. Nat. Hist., April, 1912, p. 387.

Halictus leucorhinus Cockerell.

Sandringham, V. (Rayment). Male about 10 mm. long; apical half of clypeus white, except the black margin; legs black. Resembles *H. eboracensis*, but wings darker, with darker and stronger veins.

Halictus limatiformis Cockerell (M.).

National Park, Q. (Hacker). Female about 5 mm. long; very close to *H. limatus*, but area of metathorax granular and dull, feebly plicate, with a shining margin; tegulae dark castaneous.

Halictus limatiformis scrupulosus Cockerell (M.).

Nanango District, Q. (Hacker). First tergite, and sometimes much of base of second, clear red.

Halictus limatus Smith (M.).

Tasmania. Female smaller than *H. inclinans* Sm.; mesothorax bluer, dull; abdomen shining black.

Halictus littleri Cockerell.

Launceston, Tasmania (Littler). Female about 8.5 mm. long; close to *H. circumdatus* Ckll., but clypeus rough, more closely punctured; vertex and mesothorax with conspicuous black hair; tegulae much darker. The second tergite is finely punctured, except the broad apical part, which is minutely lineolate, with only scattered rudimentary punctures.

Halictus luctificus Cockerell (M.).

Launceston, Tasmania (Littler). Female about 5.4 mm. long; head black; mesothorax dull, very dark green, scutellum dark blue, with two polished areas; abdomen shining black. Allied to *H. mundulus* Ckll., but distinguished by the shining margin of metathoracic area. Also allied to *H. dorsicyaneus* Ckll.

Halictus luteoaeus Friese (M.).

Victoria (von Müller). About as large as *H. flindersi* Ckll.; head and thorax golden green, with coppery tints on clypeus and posterior part of mesothorax; basal half of scape clear red; tegulae clear rufous; wings clear, with dark brown stigma; legs, except base, clear ferruginous, hind femora broad basally and bent in middle; abdomen shining green, curled ventral scopa large.

Halictus macrops Cockerell.

Launceston, Tasmania (Littler). Male about 5 mm. long; black, robust, looking like a female; head very large and broad; antennae entirely dark and not very long. Known from *H. niveifrons* by the broad face.

Halictus maitlandi Cockerell.

Kuranda, Q. (Turner). Type in British Museum. Female about 7 mm. long, superficially similar to *H. stirlingsi*, but structurally very different. Black; head, thorax and abdomen dullish, with a sericeous lustre; tegulae ferruginous; tibiae and tarsi rather dark chestnut red; hind tibiae and tarsi with much black hair.

Halictus mediopolitus Cockerell.

Purnong, V. (S. W. Fulton). Also Murray R., S.A. Female about 6.5 mm. long; black, with very pale ochreous-tinted or creamy hair; mesothorax and scutellum bare, highly polished; wings clear, the dusky rufous stigma very long; abdomen with dense conspicuous hair-bands at bases of tergites 2 to 4.

Halictus megastigmus Cockerell (M.).

Hobart, Tasmania (C. E. Cole). Type in Victoria Museum. Female about 7 mm. long; mesothorax shining green. Recognisable by the shining mesothorax and large stigma, which is red with broad dusky margins.

Halictus melanopterus Cockerell.

Yallingup, W.A. (R. E. Turner). Type in British Museum. Female nearly 10 mm. long. Very near *H. instabilis* Ckll., but larger, with darker wings and darker stigma, and the abdominal bands not entire. The abdomen is much like that of *H. circumdatus* Ckll., but the metathorax is quite different.

Halictus melanurus Cockerell.

York, W.A. (O. H. Sargent). Type in U.S. National Museum. Female about 4 mm. long; black, with abdomen about as far as middle of third tergite shining yellowish-ferruginous; legs dusky red, anterior tibiae in front and all the knees clear red; hind spur without teeth, only minutely serrulate or spinulose. Allied to *H. discusus*, but easily separated by the red tegulae.

Halictus mesembryanthemi Cockerell.

Sandringham, V. (Rayment), and north to Brisbane. Female about 6 mm. long; male about 5.6. For characters, see key. The abdomen is red-banded; the male suggests *H. repertus*, but has the flagellum light ferruginous beneath (entirely black in *H. repertus*).

Halictus mesocyaneus Cockerell (M.).

Bribie I., Q. (Hacker). Female about 5 mm. long; smaller than *H. inclinans*, and easily separated by the polished abdomen and black scutellum. The mesothorax is deep blue, somewhat shining, but not polished, but the thorax otherwise is black, and the head is black.

Halictus micridoneus Cockerell.

Brisbane, Q. (Hacker). Male about 4.5 mm. long; shining black, with rather short abdomen; head large and rather broad; antennae short, like those of a female. *H. idoneus* Ckll., is much larger. *H. cyclognathus* Ckll. is also allied, but *H. micridoneus* has the face much narrower. The first recurrent nervure joins third cubital cell some distance from base.

Halictus microchalceus Cockerell.

Thirroul, N.S.W. (Cockerell). Male slightly over 3 mm. long; head and thorax yellowish green, area of metathorax blue-green; abdomen greenish-black. Tibiae pale red at both ends, tarsi reddish. Differs from *H. hackeriellus* Ckll. by the much narrower head and colour of legs.

Halictus mirandus Cockerell.

Yallingup, W.A. (Turner). Type in British Museum. Female 10 to 10.5 mm. long; black, with femora (anterior ones only apically), tibiae and tarsi bright chestnut red; front and mesothorax obscurely aeneous or greenish; first tergite with a prominent keel-like tubercle (lacking in the allied *H. conspicuus* Sm.). The abdomen has patches of snow-white tomentum.

Halictus mitchelli Cockerell.

Hobart, Tasmania (J. J. Walker). Type in British Museum. Female nearly 9 mm. long; black, very like *H. warburtoni* Ckll., but not its female, as the wings are quite different, the stigma smaller and yellower (a sort of dull amber), nervures lighter, etc. For microscopical characters, see Entomologist, 1906, p. 56.

Halictus moreensis Cockerell.

Moree, N.S.W. (A. P. Dodd). Type in Queensland Museum. Female about 8 mm. long; black, with very broad abdomen (its width over 3 mm.); tibiae and tarsi entirely clear bright ferruginous; tegulae ferruginous; extreme apex of abdomen with red hair. Allied to *H. conspicuus* Sm., but with bands instead of spots on the abdomen.

Halictus mundulus Cockerell (M.).

Kalamunda, W.A. (R. E. Turner). Type in British Museum. Female about 5 mm. long; mesothorax and scutellum dark bluish green; flagellum clear ferruginous beneath; tegulae amber colour. Allied to *H. urbanus*, but mesothorax quite differently coloured.

Halictus murrayi Cockerell (M.).

Adelaide R., N.T. (J. J. Walker). Type in British Museum. Also occurs in Queensland. Thorax usually purple-blue, varying to blue-green; tegulae rufous; legs black; abdomen shining black; area of metathorax more or less distinctly plicatulate. Close to *H. urbanus* Sm.

Halictus musicus Cockerell.

Mt. Tambourine, Q. (Hacker). Also Tooloom, N.S.W. *H. trimaculatus* Friese is a synonym. Female about 10 mm. long; black, the abdomen with a faint green tint, especially on the first two tergites; postscutellum with a patch of orange tomentum; legs black, with coarse black hair; wings dilute fuscous.

Halictus nigropolitus Cockerell.

Port Darwin, N.T. (Cockerell). Female nearly 6 mm. long, robust, with very broad abdomen; pure black, including legs; mandibles red in middle. Mesothorax highly polished. Near *H. sturti* Ckll., but with different sculpture of mesothorax, and also less robust. Also near *H. semipolitus* Ckll., but much larger and more robust.

Halictus niveifrons Cockerell.

Tasmania (Lea). Also Sandringham, V. Male about 4.75 mm. long; black, with white hair, copious and snow-white on face and front; mandibles bright red at apex; clypeus with tegument entirely black; antennae wholly dark; tegulae clear testaceous; wings clear. The abdomen is broad, black, and shining.

Halictus niveorufus Friese.

Ararat, V. Female 10-11 mm. long, like *H. gibbosus* Fr. (which is a *Parasphecodes*), but abdomen clear red, first tergite without a prominence; legs black; wings dusky. Doubtless a *Parasphecodes*.

Halictus oblitus Smith.

Swan River, W.A. Female with stigma black, or practically so; area of metathorax very finely and minutely wrinkled; abdomen with hair-patches.

Halictus occidentalis Rayment (M.).

Perth, W.A. Female 5.5 mm. long; allied to *H. tarltoni* Ckll., *H. raymenti* Ckll., and *H. doweri* Raym. Legs clear ferruginous; abdomen chestnut red. The specific name is preoccupied.

Halictus olivinus Cockerell (M.).

Brisbane, Q. (Hacker). Male about 5 mm. long; slender, head and thorax shining dark olive green, the metathorax steel blue; flagellum long and slender, ferruginous beneath; wings hyaline, faintly dusky; abdomen dark brown, polished. Known from *H. hackeriellus* by the red tibiae.

Halictus opacicollis Cockerell.

Victoria (C. French). Female about 7 mm. long; black, with scanty dull white hair; flagellum very obscurely brownish beneath; hind spur of hind tibia with a large blunt tooth near the middle, and beyond that a long low keel. The mesothorax is less strongly punctured than in *H. orbatus*. Also taken at Hobart, Tasmania, by Lea.

Halictus orbatus Smith.

Widely distributed, from Tasmania to Brisbane. See characters in table. Near to *H. convervus* Sm.; see Ann. Mag. Nat. Hist., May, 1914, p. 511.

Halictus oxleyi Cockerell.

Adelaide, S.A. Type in British Museum. Male about or nearly 7 mm. long; black, with the pubescence yellowish, especially on face, where it is abundant; mandibles rufous, lighter and almost yellow in the middle; flagellum light ferruginous, above and below; nervures and stigma amber-colour.

Halictus oxoniellus Cockerell (M.).

Bribie I., Q. (Hacker). Female about 5 mm. long; head and thorax black, except the mesothorax and scutellum, which are a fine dark blue; abdomen bright ferruginous, the first tergite black, except a broad apical band, the others with black patches on extreme lateral margins; legs black, hind spur with three large teeth. Known from *H. erythrurus* by the dark stigma and blue mesothorax.

Halictus pachycephalus Cockerell.

Yarrowin, N.S.W. (W. W. Froggatt). Male about 6 mm. long, with very large broad head; legs mainly ferruginous; stigma red. Related to *H. spenceri*, but easily separated by the colour of the legs.

Halictus pavonellus Cockerell (M.).

Bribie I., Q. (Hacker). Female about 4.25 mm. long; mesothorax and scutellum dull, rich deep blue, rest of thorax very obscure blue-green; abdomen with a strong tinge of blue-green or bluish. Differs from *H. floralis* by the dark rufopiceous stigma (pale testaceous in *floralis*); the apically abbreviated stigma and blue mesothorax distinguish it from *H. dampieri*.

Halictus peraustralis Cockerell.

South Australia to Brisbane. Type in British Museum. Resembles a small Eumenid wasp. For characters, see keys.

Halictus picticornis Cockerell.

Caloundra, Q. (Hacker). Black, male about 4.5 mm. long, female 5.5 mm. Male flagellum bright ferruginous beneath, with the last three joints black; tubercles clear ferruginous. Female very near *H. plebeius* Ckll., but smaller, with yellowish and fuscous hair on hind legs. Type in Queensland Museum.

Halictus platycephalus Rayment.

Victoria. Female. Length about 4.5 mm.; black, with large broad head; mesothorax shining; wings almost clear, stigma dark ferruginous; tibiae light at end; tarsi ferruginous; hind spurs with one tooth and three nodules. Belongs to subgenus *Evyllaesus*.

Halictus plebeius Cockerell.

Purnong, V. (S. W. Fulton). Female about 6.5 mm. long, like *H. imitans*, but mesothorax and scutellum much more shining, with fine punctures; flagellum dull red beneath; stigma smaller; hind spur of hind tibiae yellowish white (red in *imitans*). Male a little over 5 mm. long; clypeus with a broad ivory-coloured band on apical half; flagellum long and rather thick, obscurely brownish beneath; legs black, with very slender reddish-brown tarsi; abdomen shining, not hairy.

Halictus pulvinctus Cockerell.

Eaglehawk Neck, Tasmania (Turner). Type in British Museum. It was also reported from Sandringham, V., but this was really *H. victoriellus* Ckll. Female 6.5 to 7 mm. long; black, with hind margins of tergites testaceous. Male about 6 mm. long; clypeus with an apical cream-coloured band; flagellum long, very slightly brownish beneath; tegulae ferruginous. *H. victoriellus* is smaller, with a much more finely punctured mesothorax.

Halictus punctatus Smith (M.).

Mesothorax green, with very large shallow punctures; abdomen very shiny, red at sides. Female. The name is preoccupied, and I have suggested that the species may be called *H. exlautus* (Ckll.), based on *H. punctatus exlautus* Ckll. For characters and localities, see Ann. Mag. Nat. Hist., April, 1912.

Halictus punctatus exlautus Cockerell (M.).

Abdomen entirely orange-fulvous (apricot colour), except a faint dusky median stain and a small black spot at each side of tergites 3 and 4. The legs are red. Type in British Museum. See Ann. Mag. Nat. Hist., June, 1922, p. 662.

Halictus purnongensis Cockerell (M.).

Purnong, V. (S. W. Fulton), and north to Brisbane. Male 5 mm. long; head and thorax shining olive-green; abdomen piceous, with first tergite dark greenish; head very large, with toothed cheeks.

Halictus raymenti Cockerell (M.).

Sandringham, V. (Rayment). For characters, see tables. Female about 5.5 mm. long. Resembles *H. erythrurus*. Associated with this species is the Chloropid fly *Ephydroscintis raymenti* Curran.*

Halictus repertulus Cockerell.

Brisbane, Q. (Hacker). Male about 5.5 mm. long; black, moderately robust; nearly the apical half of clypeus very pale yellow; flagellum only moderately long, very obscure reddish beneath. The rufous tegulae distinguish it from *H. bursariae*; the head is not so broad as in *H. cambagei*, and the mesothorax is more regularly and distinctly punctured. It is smaller than *H. repertus*.

Halictus repertus Cockerell.

Near Melbourne, V. Also taken by Charles Darwin at Hobart, Tasmania. The male differs from *H. cambagei* by having the tarsi red, and the area of metathorax with evident ridges; it is larger than *H. isthmalis*, and has the ridges absent from apical part of area (not thus limited in *isthmalis*), and the tibiae dark (tibiae red in *isthmalis*). Length about 6.5 mm.

Halictus repraesentans Smith.

Hobart, Tasmania (J. J. Walker). Area of metathorax with strong regular striae. For other characters, see tables. For microscopical characters, see Entomologist, December, 1905, p. 302.

Halictus rowlandi Cockerell.

Kuranda, Q. (Turner). Type in British Museum. Female hardly 5 mm. long; thorax and legs entirely light rufofulvous, the coloration recalling that of the wasp *Pison melanocephalum* Turner, living in the same district.

Halictus rufibasis Cockerell.

National Park, Q. (Hacker). Type in Queensland Museum. Female about 5 mm. long; robust, with very broad abdomen; head and thorax shining black; abdomen with first tergite clear ferruginous, second broadly red basally; hind tibiae and tarsi with stiff black bristles.

Halictus ruficollis Friese.

Adelaide, S.A. Male 9 mm. long, the thorax red, except the black scutellum and metanotum; abdomen with tergites 1 to 3 reddish-yellow, 4 and 5 brown, 6 and 7 black; legs red, with yellow tarsi; wings dusky, with dark margin. From the description seems near *Parasphecodes aurantiacus* Ckll. Friese compares it with *H. pilicollis* Fr., which is *Parasphecodes basilautus* Ckll.

Halictus rufipes Smith.

Melbourne, V. All the femora rufous. This is *H. tertius* Dalla Torre.

* Curran describes this (Amer. Mus. Novitates, June 10, 1930) from the female. Rayment (Victorian Naturalist, March, 1931) describes the male of what must apparently be the same species as *Neoborborus speculabundus*, placing it in Borboridae.

Halictus rufoaeneus Friese (M.).

Sydney, N.S.W. Collected in the Botanic Gardens, 1897. Female 5 to 5.5 mm. long, like *H. luteoaeneus*, but smaller, with brown legs and reddish tarsi. Wings clear.

Halictus rufotinctus Cockerell (M.).

Brisbane, Q. (Hacker). Female 4 to 4.25 mm. long; robust, with short broad-oval abdomen; mesothorax and scutellum olive-green (in var. a. the mesothorax is dark blue-green); abdomen largely castaneous; legs black. Allied to *H. inclinans* Sm.

Halictus sanguinipes Cockerell.

Windsor, V. (French). Male about 8 mm. long; black, with bright chestnut-red legs; clypeus with a very broad pale yellow band; mandibles black; wings reddish. Known from *H. bicingulatus* by the clavate abdomen, the tegulae piceous with a rufo-testaceous spot, and the basal area of metathorax very long, irregularly wrinkled.

Halictus saycei Cockerell (M.).

Mackay, Q. (Turner). Type in British Museum. Female about 4.5 to 5 mm. long; thorax black, with the dull and granular mesothorax dark green; abdomen smooth and shining, wholly without bands; scape red basally, flagellum dark. Allied to *H. limatus*.

Halictus sculpturatus Cockerell.

Stradbroke I., Q. (Hacker). Male about 6.5 mm. long; black, moderately robust, the abdomen without hair-bands or patches; clypeus with a transverse cream-coloured band; mesothorax shining, strongly punctured, median groove strong, and on each side of it anteriorly oblique striae. Allied to *H. spenceri* Ckll., but mesothorax and area of metathorax quite different.

Halictus seductus Cockerell.

Windsor, V. (French). Also Sandringham, V., and Bridport, Tasmania. Female about 10 mm. long; black, robust, with greyish-white hair, mixed with fuscous on vertex and mesothorax. Resembles *H. repraesentans*, but easily separated by the mesothorax, which is roughened and strongly punctured, dull, with the disc somewhat shining. The wings are smoky hyaline, the stigma and nervures dusky ferruginous.

Halictus seminitens Cockerell.

Wyalcatchem, W.A. (Nicholson). Type in Australian Museum. Female about 7.3 mm. long; fairly robust, black, including mandibles, antennae and legs; face very broad. Very like *H. orbatus* Sm., *H. instabilis* Ckll., and *H. imitans* Ckll., but easily known by the contrasting polished and dull areas on mesothorax, and the dark tegulae.

Halictus semipolitus Cockerell.

Bribie I., Q. (Hacker). Also Brisbane and Tambourine Mtn. Female about 5.5 mm. long, black; tegulae dark reddish; wings strongly smoky, stigma dark brown. Close to *H. blackburni* Ckll., but mesothorax shining, especially posteriorly, the scattered punctures extremely minute and hardly visible; area of metathorax dull, covered with fine wrinkles.

Halictus semipolitus expulsus Cockerell.

Georgetown, Tasmania (Littler). Female with flagellum black (red at end in typical *H. semipolitus*); tegulae piceous or more or less reddish.

Halictus speculellus Cockerell.

Brisbane, Q. (Hacker). Female about 5 mm. long; black, with labrum and mandibles (except base) dull red; flagellum ferruginous beneath; tegulae clear rufo-testaceous. Very like *H. repertulus* Ckll. (male), but not its female, as *repertulus* has a distinctly punctured mesothorax. Also allied to *H. sturti* Ckll., but smaller, with more dusky wings, and different metathorax.

Halictus spenceri Cockerell.

Yallingup, W.A. (R. E. Turner). Type in British Museum. Male about 7 to a little over 8 mm. long; a large species of the group of *H. cambagei*, the apex of abdomen with a large, broad, rounded, bright ferruginous plate. The clypeus has a triangular creamy-white patch; antennae long, black.

Halictus sphecoides Smith (M.).

Female with mesothorax duller than in *H. vitripennis* Sm.; abdomen with the apical part dark; stigma fuscous.

Halictus sphecodopsis Cockerell (M.).

Mackay, Q. (Turner). Type in British Museum. Male scarcely 4 mm. long; head and thorax yellowish green, the metathorax a bluer green; face broad, covered with yellowish hair; broad anterior margin of clypeus, labrum and mandibles (except ferruginous tips) cream-colour; antennae long, ferruginous, flagellum dusky above; legs clear orange-ferruginous; abdomen bright ferruginous, the apical third dusky.

Halictus stirlingi Cockerell.

Mackay, Q. (Turner). Type in British Museum. Female about 6.5 mm. long; very robust; abdomen with bands of dense fulvous tomentum at bases of second and third tergites. Related to the *H. bicingulatus* group, but known by the small size, dark legs, and peculiar sculpture of metathorax.

Halictus sturti Cockerell.

Mackay, Q. (Turner). Type in British Museum. *H. globularis* Friese is a synonym. Female a little over 6 mm. long; black, broad and robust, with scanty white hair; mesothorax shining, overlapping prothorax in front; hind spur of hind tibia with three little sharp teeth close together about the middle, but otherwise simple.

Halictus subcarus Cockerell (M.).

Halifax, Q. (Williams). Type in Museum of Comparative Zoology, Harvard. Mesothorax and scutellum bright prussian green, the former dull, the latter more shining, but not polished; tegulae clear fulvous; abdomen olive green. Length about 5 mm. Known from *H. pavonellus* Ckll. by the larger head, with more produced clypeus, green mesothorax and clear red hind tibiae.

Halictus subinclinans Cockerell (M.).

Launceston, Tasmania (Littler). Also Sandringham, V. Female 6.25 mm. long; mesothorax dark green, dullish; abdomen shining brownish black. Differs from *H. inclinans* by the greater size, darker tegulae and dark legs. The hind spur of hind tibia has a single large broadly rounded (subtruncate) tooth, and a low broad (wave-like) one beyond.

Halictus subplebeius Cockerell.

National Park, Q. (Hacker). Type in Queensland Museum. Male about 6.8 mm. long; black, rather robust, the abdomen broad for a male;

clypeus with a broad creamy white band. Resembles *H. plebeius* Ckll., but much larger, with dark tegulae and different metathorax.

Halictus suburbanus Cockerell (M.).

National Park, Q. (Hacker). Type in Queensland Museum. Female hardly 5 mm. long; mesothorax and scutellum dull emerald green; abdomen shining black. Near to *H. urbanus* Sm., but the mesothorax is larger and duller. Also near *H. williamsi* Ckll., but mesothorax more shining, and bluer green, and scutellum shining.

Halictus supralucens Cockerell.

Kaiamunda, W.A. (R. E. Turner). Type in British Museum. Female about 6.5 mm. long; near *H. mediopolitus*, but sculpture of mesothorax entirely different (shining, with irregular large and small punctures); known from *H. orbatus* by the polished scutellum.

Halictus tarltoni Cockerell (M.).

Brighton, V. (Rayment). Female about 5.5 mm. long; black, with blue-green mesothorax and red abdomen; stigma clear but dull red; abdomen with a ventral scopa. Very close to *H. raymenti*, but anterior tibiae clear red in front, and abdomen with no basal dark patch. The dull clypeus separates it from *H. erythrurus*.

Halictus tasmaniae (Cockerell).

Hobart and St. Helens, Tasmania. Type in British Museum. Male about 5.5 mm. long; head and thorax black; legs bright ferruginous, marked with black; abdomen black basally and apically, with apical margin of first tergite, second except a median stain, and greater part of third chestnut red. Apical plate red, broadly truncate. Erroneously described under *Sphecodes* (1905), but transferred to *Halictus* in 1910.

Halictus tatei Cockerell (M.).

Mackay, Q. (Turner). Type in British Museum. Female about 5 mm. long; thorax black, with the mesothorax green and the tubercles ferruginous. Near to *H. sphecodoides*, but middle tibiae red, and abdomen not black at base, though there is a black spot on each side.

Halictus tertius Dalla Torre.

Melbourne, V. Also Lake Hattah. This is *H. rufipes* Smith, pre-occupied. I formerly thought this a synonym of *H. bicingulatus*, but it has all the femora rufous; pubescence at base of second and third tergites fulvous. See also characters given in the key.

Halictus urbanus Smith (M.).

Widely distributed, from Champion Bay, W.A., to Port Darwin, N.T., and Sydney to Brisbane. Female with mesothorax peacock-green; abdomen shining; hind spur of hind tibia with three spines.

Halictus urbanus baudinensis Cockerell (M.).

Baudin I., N.W. (Australia) (J. J. Walker). Type in British Museum. Taken on The "Penguin" Expedition. Female about 5 mm. long; tibiae and tarsi, and apical third or fourth of femora, all bright ferruginous; stigma very dark reddish brown. The hind spur has two long spines.

Halictus urbanus lomatiae Cockerell (M.).

Brisbane, Q. (Hacker). Female with mesothorax peacock-green; scutellum bright blue, highly polished; legs rufotestaceous; flagellum bright ferruginous beneath. Visits *Lomatia*.

Halictus urbanus stradbokensis Cockerell (M.).

Stradbroke and Bribie Islands, Q. Larger (female slightly over 6 mm. long), with black legs.

Halictus veronicae Cockerell (M.).

Sandringham, V. (Rayment). Female about 5.5 mm. long; shining olive-green; male with middle of mandibles, labrum and lower end of clypeus light yellow. The male suggests *H. purnongensis*, but the head is small, and abdomen green, light red at apex.

Halictus victoriae Cockerell (M.).

Sandringham, V. (Rayment). Female about 5.5 mm. long; head, thorax and abdomen bluish green, the metathorax almost black, the very short clypeus dark purplish; mesothorax polished, brilliant green, the anterior middle almost steel blue.

Halictus victoriellus Cockerell (M.).

Sandringham, V. Female a little over 6 mm. long; like *H. imitans*, but smaller and less robust, with flagellum dull red beneath, mesothorax more shining and finely punctured, stigma testaceous, hind margins of tergites suffused with reddish. The hair of venter is short and not abundant (it is abundant in *H. imitans*).

Halictus viridarii Cockerell.

National Park, Q. (Hacker). Type in Queensland Museum. Male about 7 mm. long, black, rather stout, with a broad transverse pale yellow band on clypeus; legs black. Resembles *H. excusus* Ckll., but area of metathorax (large, shining apically, covered with fine plicae) and abdomen quite different. The abdomen has patches of greyish hair at lateral bases of second and third tergites; in *H. excusus* it is without hair-bands or spots.

Halictus viridinitens Friese (M.).

Sydney, N.S.W. Female 7 to 8 mm. long, shining blue-green. Legs and antennae brown, the flagellum red beneath. Abdomen bluer than thorax. Wings clear.

Halictus vitripennis Smith (M.).

Champion Bay, W.A., but *H. sphecodoides* var. *mackayensis* Friese, from Mackay, Q., is the same. Female with mesothorax very shiny; abdomen red, with only first tergite darkened. The male is described by Rayment in Jn. Roy. Soc. W. Australia, xvii., p. 170. Length about 4.7 mm., face entirely covered with cream-coloured appressed small scale-like hairs; clypeus clear fulvous. The female var. a. has the first tergite red, with a transverse dark mark.

Halictus vividus Smith (M.).

Swan River, W.A. I cannot distinguish this from *H. floralis* Smith. Rayment (Jn. Roy. Soc. W. Australia, xvii., p. 167) treats it as a valid species, and says it is very close to *H. victoriae* Ckll., but area of metathorax is covered with fine striae, without the wide smooth shining rim of *H. victoriae*.

Halictus warburtoni Cockerell.

Hobart, Tasmania (J. J. Walker). Type in British Museum. Male about 10 mm. long; black, the pubescence dull white, with some black or dark fuscous on vertex and dorsum of abdomen; clypeus with rather more than anterior half light lemon-yellow. Compared with *H. lanarius* Sm.,

the pubescence is much less abundant; the head, seen from in front, is broader and more triangular; the stigma is much larger; and the area of metathorax is quite different.

Halictus waterhousei Cockerell.

Woodford, N.S.W. (G. A. Waterhouse). Type in British Museum. Female 10 mm. long; male the same, but more slender, the very long flagellum entirely black. Allied to *H. musicus*, but with rufo-testaceous tegulae, and the arrangement of hair on thorax, and sculpture of mesothorax and abdomen different. The anterior wings are suffusedly blackened at apex.

Halictus williamsi Cockerell (M.).

Halifax and Babinda, Q. (Williams). Type in Museum of Comparative Zoology, Harvard. Mesothorax and scutellum dull, yellowish green; metathorax dark green, the basal area coarsely plicate, with heavy obtuse margin; femora black, knees, tibiae and tarsi bright ferruginous; abdomen shining black, hind margins of tergites coppery reddish. Length about 5.5 mm. (female). Male hardly 3.5 mm. long, more slender, antennae black, flagellum not very long; no light mark on clypeus. Known from *H. mundulus* Ckll. by the dark stigma. Male known from *H. hackeriellus* Ckll. by the red tibiae, and dull dark front of head.

Halictus willsi Cockerell.

"New Holland." Type in British Museum, which received it in 1844. Female about 6 mm. long; black, with dull white pubescence; tegulae shining dark rufous; stigma and nervures rufous; area of metathorax very finely striate; hind spur of hind tibia with a broad, strongly divergent blunt tooth about the end of its first third, and beyond that only a single broad low rounded lamella. For microscopic characters, see Entomologist, 1906, p. 56.

Halictus woodsi Cockerell (M.).

Cooktown, Q. (Turner). Type in British Museum. Also Port Darwin, N.T. Female about 6.5 mm. long, the head narrower than in *H. flindersi*. The male (with red tibiae) differs from *H. dampieri* by the shorter flagellum and bluish abdomen.

REVISIONAL NOTES ON AUSTRALIAN THEREVIDAE.

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Part 3.

Introduction.

Since the publication of the first two parts * of these notes much additional material has been located, but insufficient is available to allow of a complete revision of the family for the present.

Of the genera *Psilocephala* and *Belonalys* of Group 1 not dealt with previously, the former is considered in the ensuing pages, but the latter has to be left in abeyance pending the recognition of the species; however, it is probably a synonym of *Psilocephala*. *Pseudoloxocera*, *Oldenbergia* and *Parapsilocephala* of Group 2 were not reviewed formerly. In this part, *Oldenbergia* is placed as a synonym of the latter, which is fully described. The former genus has not been recognised, but is probably a synonym of *Psilocephala*. The genus *Spatulipalpa*, which may belong to either Group has not been recognised, and its affinities cannot be judged from the description given by Krober; therefore it will still have to be left in abeyance.

In this, the concluding part of the series, nine species are described as new, five old descriptions are revised and references and notes are given for ten species unknown to the writer. Keys are given for the determination of species of *Ectinorrhynchus*, *Psilocephala* and *Parapsilocephala*.

Genus PSILOCEPHALA.

Psilocephala Zetterstedt, Ins. Lappon. Dipt., 525, 1838. *Id.*, Dipt. Scand. 1, 19, 1838 (*Psilocephala*, lapsus); Brunetti, Fauna Brit. India, Vol. 1, 302, 303; Krober, Ent. Mitt. 1., 247, 1912; White, Proc. Roy. Soc. Tasm., 1915; Mann, Aust. Zool., v., pt. ii., 1928.

Small or medium sized stout species with the head subhemispherical or somewhat pyriform, slightly broader than long and slightly broader than the thorax; occiput deeply concave with a median indentation and furnished with black bristles and hairs; eyes bare and in the males large and descending well down on to the cheeks, closely approximated below the ocellar tubercle and in the females much smaller in comparison and widely separated; front sometimes with a bulbous protuberance above the antennae and mostly with frontal spots, small and triangular in the males and broad in the females; ocellar tubercle more or less triangular, raised and bearing tufts of hair; ocelli three in number and fairly widely separated; antennal tubercle sometimes fairly prominent; antennae shorter than the head and in relation to the anterior margins of the eyes they are inserted at about two-thirds their depth, they project forward and are composed of three primary segments with a two-segmented style (doubtful in *P. nitens* White) which bears an apical arista; segment 1 is more or less cylindrical; 2 more or less globular and 3, when viewed in profile, broadly conical; face and cheeks small; proboscis and two-segmented palpi small and mostly well retracted into the buccal cavity.

Thorax slightly longer but deeper than broad, twice as long as the head, more or less convex above, spotted, mottled or striped and bearing a few bristles and hairs; scutellum semicircular and furnished with at least

* Part 1, this journal, vol. v., pp. 151-194, Part 2, vol. vi., pp. 17-49.

2 marginal bristles; postscutellum convex and well hidden beneath the scutellum.

Abdomen more or less conical, flattened dorsally and ventrally and silvery pollinose in the males and very much shorter than in the females; genitalia of males large and conspicuous.

The legs are of normal length, the tibiae and tarsi being furnished with numerous bristles, but the femora in all species before me are devoid of such.

Wings hyaline, tinged or spotted and possibly banded in *P. venusta*; M3 may be closed near to, at, or well before the border; Cul coalesces with 1A well before the wing margin; R4 joins the border well above the wing tip and this vein is usually curved. M3 may, or may not be complete and reach the wing margin; M1 and M2 may arise together from the medium cell and remain joined for a short distance before branching away.

Genotype: *Bibio imberis* Flin. (Sweden) by Coquillett's designation, 1910. Brunetti notes that "it would have been better to have selected the well known European *ardea* F., as genotype."

Range: Europe, Asia, North, Central and South America, North and South Africa, Madagascar, Sokotra and Australasia.

Distribution of the Australian species: Of the 12 species described from Australia, six are confined to Tasmania, one to Victoria and three to New South Wales, one species extends from New South Wales into Queensland and one species is uncertain, the locality being given by Krombein as Australia.

The wing venation of this genus, unlike that of other genera of the family in Australia, seems to be inconsistent, for species which are otherwise congeneric exhibit a remarkable divergence. In this genus the main character for grouping the genera, as outlined in the first paper of this series,* has broken down and species of *Psilocephala* could be referred to either group. However, as far as these studies have progressed, this is the only genus where there is any departure from this general principle.

The species are apt to become greasy in collections, so that determinations can be made on fresh material only.

It is important to notice that the variation of the wing venation of *tristriata* sp. nov. further suggests that *Pseudoloxocera* Krombein will eventually have to be regarded as a synonym of this genus. It is also considered that *Belonalys* Krombein will be placed here when the species are recognised and regarding this genus White notes (Proc. Roy. Soc. Tasman., 1915) that "the venation of Krombein's genus *Belonalys* is very similar to that of *P. lutea* and *P. occulta* and the genus may belong here."

Key to the species of Psilocephala Zetterstedt.

- | | |
|---|------------------------|
| 1. Females | 2. |
| Males | 10. |
| 2. Species with large shining black protuberance above the antennae | <i>aggera</i> sp. nov. |
| Species without such | 3. |
| 3. Large species (more than 6 mm. in length) | 4. |
| Small species | 8. |
| 4. Antennae, front and thorax wholly black, abdomen dark brown, wings mottled black | <i>occulta</i> White. |
| Antennae not wholly black | 5. |

* Aust. Zool., v., 1928, 151.

5. Eyes furrowed transversely 7.
Eyes not furrowed 6.
6. Antennae with two basal segments shining black and the apical bright brown; front and thorax dark brown; abdomen grey; legs mainly brown *duocoloris* sp. nov.
Antennae bright orange; front and thorax black; abdomen black-brown; legs bright yellow with brown tarsi *venusta* Erinsch.
Antennae wholly orange; thorax brown; abdomen dull orange; legs bright orange *rufa* Krober.
7. Antennae with basal segment brown and apical segments orange; thorax and legs light brown; abdomen dark brown *saxatilis* White.
8. Antennae wholly black 9.
Antennae wholly brown; thorax yellow-brown; abdomen brown; legs mainly light brown; brown tinged wings faintly spotted *lutea* White.
9. Front, thorax and abdomen grey; legs mainly black; brown tinged wings distinctly spotted *tristriata* sp. nov.
Front white and brown; thorax yellow and grey; abdomen grey; legs red; wings yellow *nudifemorata* Macquart.
10. Antennae wholly black; front, thorax and abdomen grey; legs mainly black; brown tinged wings distinctly spotted *tristriata* sp. nov.
Antennae, front and abdomen coloured otherwise 11.
11. Antennae of two colours 12.
Antennae of one colour 13.
12. Antennae with two basal segments shining black and the apical bright brown; abdomen bright yellow brown, slightly silvery pollinose only; legs mainly brown; brown tinged wings indistinctly spotted *duocoloris* sp. nov.
Antennae with basal segment brown and two apical segments orange; thorax light brown; abdomen dark brown; legs mainly light brown; brown tinged wings indistinctly spotted *saxatilis* White.
13. Antennae brown; thorax yellow-brown; abdomen brown; legs mainly light brown; brown tinged wings faintly spotted *lutea* White.
Antennae yellow; thorax grey; abdomen brownish; legs mainly yellow-brown; wings almost colourless a faint indication of brown tinging only *nitens* White.

The characters of *nudifemorata* Macquart, *venusta* Erisch., *occulta* White, *rufa* Krober and *saxatilis* White, as incorporated in the above key, are taken from the original descriptions of the species. These five species have not been recognised by the writer to date. *P. curta* Krober and *P. lateralis* Krober are not included in the key at all.

It will be seen that, of the 12 Australian species referred to this genus, two are known from the males only and five from the females only, leaving but five species in which both sexes have been recognised.

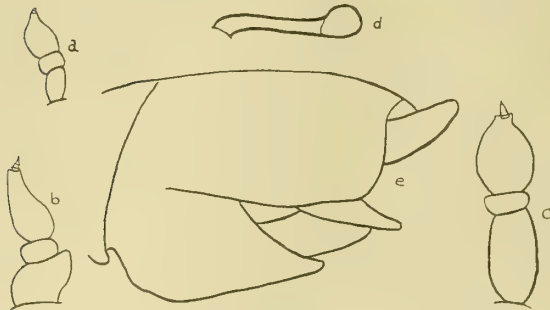
In the material before me 10 further species are represented by few or damaged specimens, and these will not be dealt with until more or better conditioned specimens are available.

PSILOCEPHALA AGGERA sp. nov.

Length: 6-8 mm.

Female: Head subhemispherical with the grey occiput thickly beset with black hairs and bristles; eyes separated on the vertex by twice the width of the ocellar tubercle with the anterior margins straight and widely diverging; front grey with brown frontal spots which are confluent and

REVISIONAL NOTES ON AUSTRALIAN THEREVIDAE



Text Fig. 1.

- a. Antenna of *Psilocephala lutea* White.
- b. Antenna of *Psilocephala aggera* sp. nov.
- c. Antenna of *Psilocephala duocoloris* sp. nov.
- d. Palp of *Psilocephala duocoloris* sp. nov.
- e. Male genitalia of *Psilocephala nitens* White, Holotype. (After Hardy).

form an irregular broad transverse band; above the antennae the front is considerably raised to form a shining black bulbous projection which is transverse and joins the eye margins on either side; antennae black with the third segment and style bright brown; segment 1 slightly less than half the length of 3 and when viewed vertically is broader than this segment but viewed in profile it is narrower; 2 half the length of 1; 3 broadly conical (profile view) and somewhat longer than 1 and 2 together; the two-segmented style is short and has both its segments equal in length but very difficult to discern; the arista is stout, conical and almost as long as the style; face and cheeks grey, the latter clothed with long fine whitish hair; proboscis brown; palpi yellowish and almost as long as the proboscis.

Thorax grey mottled thickly with brown irregular spots, furnished with two rows of dorso-central, three pre-alar, at least one supra-alar and two post-alar bristles, all of which are black and weakly developed; pleurae grey; scutellum grey with brown mottling and bearing two marginal bristles; postscutellum grey.

Abdomen dark brown, segment 2 broadly margined anteriorly with grey, apical segment light brown; genital spines black; venter brown.

Legs brown, coxae, femora and apices of tibiae and tarsi black.

Wings tinged brown and thickly mottled with large and often confluent brown irregular spots; cell M3 closed; R4 decumbent for slightly more than half its length and then curving upward. The halteres are light brown with yellow apices.

The male is unknown.

Variations: Cell M3 may be narrowly or broadly open or it may be closed at or before the wing margin. The mottling of the wings may be extensive or somewhat reduced.

Holotype: Female, Chinchilla (Queensland), August, 1930 (J. Mann) in the Queensland Museum. Paratypes in the C.S. & I.R. Museum at Canberra, the Institute of Tropical Medicine, Sydney, the Australian Museum, Sydney, and the author's collection.

Habitat: Chinchilla (Queensland), 7 ♀, August, 1930 (J. Mann); Nyngan (New South Wales), 2 ♀ (J. Armstrong).

The bulbous protuberance above the antennae is a character to which Krober gave generic status in his *Oldenbergia*; it is also reminiscent of *Pherocera* Cole (North America). The former genus is considered by the writer as synonymous with *Parapsilocephala*, since a gradation of the character is apparent in species of this group. The wing venation of the species herein described would place it in either *Psilocephala* or *Parapsilocephala*, but other characters seem to relegate it to the former and it is placed here tentatively until the male is discovered.

PSILOCEPHALA DUOCOLORIS sp. nov.

Length: 7-12 mm.

Male: Head somewhat pyriform with the occiput brown, median indentation bilobate apically and furnished with a row of weak black bristles around the eye margins; eyes separated on the vertex by the width of the ocellar tubercle with the anterior margins convex, closely approximated but not touching for two-thirds of the distance to the antennae and from thence convexly diverging; front dark brown; antennal tubercle prominent shining black with brown tomentum and pubescence; antennae with the two basal segments shining black and the apical bright brown; segment 1 slightly longer than 3 but not as long as 2 and 3 together, furnished with numerous long black bristles and hairs; 2 one-fourth the length of 1 and likewise furnished with bristles and hairs; 3, when viewed in profile, is broadly conical and slightly less than the length of 1; the two-segmented style together with the arista is almost as long as the second antennal segment, the first segment is small and received into an apical indentation of the third antennal segment and so is very difficult to discern, the second segment is elongate conical; face and cheeks grey, the latter bearing long fine greyish hair; proboscis light brown and projecting as far forward as half the length of the first antennal segment; palpi yellowish and two-thirds the length of the proboscis.

Thorax dark brown with indications of 3 light brown parallel longitudinal stripes which are interrupted after the dorsal third, humeral calli, sides and anterior margin yellowish; furnished with dorso-central bristles which are very weakly developed, 3 pre-alar, 1 supra-alar and 1 post-alar, all of which are black; pleurae shining brown ornamented with a shining grey longitudinal stripe; scutellum shining brown and furnished with two marginal bristles; postscutellum black.

Abdomen bright yellow-brown, slightly silvery tomentose, segments 2 and 3 apically margined yellowish and 3 with the anterior margin black; venter and genitalia brown.

Legs brown, apices of tibiae and first tarsal segments and whole of remaining tarsi, black.

Wings tinged brown and indistinctly spotted; venation dark brown and well defined; R₄ almost straight for two-thirds its length and then concavely joining the wing border well above the wing tip; cell M₃ closed well before the border and this cell is narrower and longer than the median. The halteres are yellow with brown apices.

The female differs from the male, in addition to the usual sexual characters, in having the eyes separated on the vertex by twice the width of the ocellar tubercle, the third antennal segment somewhat blackish, the proboscis bright brown, the elongated abdomen mainly black-brown with

the three apical segments shining and 2-5 apically margined brownish yellow and in having the anterior femora with black reflections.

The Holotype male and Allotype female, Denman (New South Wales), April, 1929 (A. P. Dodd) are in the Queensland Museum, paratype males are in the C.S. & I.R. Museum at Canberra, the author's collection, and the Australian Museum, Sydney.

Habitat: New South Wales; Denman 10 ♂, 1 ♀, April, 1929 (A. P. Dodd).

A somewhat aberrant species in that it has the pyriform head. It is readily recognised by the thoracic coloration.

PSILOCEPHALA LUTEA.

Psilocephala lutea White, Proc. Roy. Soc. Tasm., 1915, fig. 1; *Id.*, Mann. Aust. Zool., vol. v., pt. ii., 193, 1928.

Length: 5-9 mm.

Male: Head subhemispherical; occiput grey, fringed along the eye margins with short and fairly weakly developed black bristles; eyes separated on the vertex by the width of the ocellar tubercle and closely approximated below this for half the distance to the antennae and from thence concavely diverging; visible portion of the front brown until close to the antennae, where it is yellowish, ornamented with a longitudinal median furrow for a short distance above the antennae, frontal spots indistinct, separated and contiguous with the eye margins; antennae brown, segments 1 and 2 grey tomentose, segment 1 two-thirds the length of 3; 2 slightly broader than 1 and slightly less than half as long; 3 a little longer than 1 and 2 together and broader than either; the two-segmented style is less than half the length of the second antennal segment and has both its segments about equal in length; the arista is half the length of the style; face yellowish; cheeks grey and bearing long fine similarly coloured hair; proboscis light brown; palpi light brown and three-fourths the length of the proboscis.

Thorax yellow-brown with three brown dorsal stripes, the median one extending from the anterior margin for three-fourths the distance to the hind margin as a broad stripe with an indication of being divided in the middle, but from thence to the hind margin it is changed into a narrow stripe, the lateral stripes are interrupted and suggest confluent irregularly triangular patches; furnished with two rows of six dorso-central bristles, three pre-alar and two supra-alar, which are all black and weakly developed; pleurae grey with some yellowish tomentum; scutellum yellow-brown with a median brown irregular spot and furnished with two marginal bristles; postscutellum grey.

Abdomen brown, silvery pollinose except for the extremity and the genitalia; venter greyish.

Legs light brown, femora grey tomentose, apices of posterior tibiae and tarsi black.

Wings tinged brown with faint indications of brown spots; cell M3 open; R4 decumbent for two-thirds its length and then curving upwards.

The female differs from the male, in the following respects, in addition to the usual sexual characters:—Occiput yellow-brown; eyes separated on the vertex by as much again as the width of the ocellar tubercle, anterior margins straight and widely diverging; frontal spots almost touching; front ornamented with a shallow transverse indentation on the vertical third and with indications of two median calli; third antennal segment bright brown.

Abdomen bright yellow-brown with large dark brown semicircular patches on each segment and these patches decrease in size towards the extremity of the abdomen; venter brown.

Variations: In some males of the series before me M3 does not reach the wing margin.

When White described the species in 1915 he did not know the male, so this sex is herein described for the first time and the Allotype male is in the Queensland Museum.

Habitat: King Island (Tasmania), 12 males, 6 females (A. M. Lea).

The small size, together with the general yellow-brown coloration will separate this species from all other known members of the genus in Australia.

White noted that the species occurred "very sparingly" and frequented "small pools in the bush," or "settled on bracken or windows."

PSILOCEPHALA TRISTRIATA sp. nov.

Length: 3-6 mm.

Male: Head subhemispherical with the occiput grey and fringed around the eye margins with black bristles and hairs; eyes separated on the vertex by the width of the ocellar tubercle and with the anterior margins converging below this and barely touching for two-thirds the distance to the antennae and from thence convexly diverging; front grey with a deep median longitudinal furrow and with two conspicuous dark brown frontal spots which are placed one on either side of the median furrow and contiguous with the eye margin; antennal tubercle hardly present and coloured as the front; antennae black, first two segments grey tomentose and furnished with numerous black bristles and hairs, segments 1 and 3 equal in length, the latter broadly conical; the style has its two segments equal in length and together with the arista is almost as long as the second antennal segment; face and cheeks grey, the latter bearing long fine similarly coloured hair; proboscis brown and projecting as far forward as the apex of the first antennal segment; palpi light brown and three-fourths the length of the proboscis.

Thorax grey, ornamented with three dark brown dorsal stripes, the median one of which is broad on the anterior half and divided longitudinally by a grey stripe and is narrow on the posterior half, the lateral stripes are interrupted on the anterior half; furnished with two complete rows of dorso-central bristles, 3 pre-alar, 1 supra-alar and 1 post-alar, all of which are black; pleurae grey; scutellum grey with a dark brown median longitudinal stripe and furnished with two marginal bristles; postscutellum grey-black.

Abdomen grey and silvery pollinose, segments 2-4 apically margined whitish; venter black and grey; genitalia brown.

Legs black, tibiae with basal four-fifths and bases of first three tarsi on each leg, brown.

Wings tinged brown and fairly conspicuously mottled or spotted with dark brown; R4 convexly diverging from R5 and then running practically straight to the wing border which it joins slightly above the tip; M1 and M2 issue from the median cell together and are joined for a very short distance before branching away from each other; cell M3 open; Cul coalesces with 1A well before the wing border. The halteres are light brown.

The female differs from the male, in addition to the usual sexual characters, in having less distinct frontal spots, M1 and M2 issuing from the median cell considerably apart from each other, and in having a much

more pyriform head with a considerably more distinct antennal tubercle.

Holotype male and Allotype female, Kiata (Victoria); October, 1928 (F. E. Wilson) returned to the collector. One paratype female (same data) in the author's collection.

Habitat: Victoria, as above, and one further female which is almost too greasy to recognise and which in consequence thereof is not labelled as a paratype.

The wing venation of the male of this species suggests Krobe's *Pseudolorocera* which genus was proposed for a female specimen of an insect from Peak Downs, in which the veins M1 and M2 arose "together as forked veins from the upper corner of the discoidal cell" and this character was used as the primary one for establishing the genus. This character was found to be of little or no importance in the genus *Acraspisa* where considerable variation was found in one species (*A. obscuripes* Mann).^{*} It seems more certain now that Krobe's genus cannot be maintained, but until his species is recognised the possible synonymy will have to be left in abeyance.

This species can be distinguished by the size, general colour and wing venation.

PSILOCEPHALA NITENS.

Psilocephala nitens White, Proc. Roy. Soc. Tasm., 1915; *Id.*, Mann, Aust. Zool., vol. v., pt. ii., 193, 1928.

Length: 5 mm.

Head subhemispherical with the occiput grey and fringed around the eye margins with a row of black bristles; eyes separated on the vertex by the width of the ocellar tubercle and converging below this and touching for a short distance and from thence diverging; front yellow-brown with a deep median longitudinal furrow; frontal spots brown, indistinct and contiguous with the eye margins; antennae yellow; segment 1 scarcely as long as 3; 2 very short and 3 almost as long as 1 and 2 together; the style is very short and, as far as can be determined without removing same, is composed of one segment only; the arista is almost as long as the style; face yellowish; cheeks grey and bearing long fine similarly coloured hair; proboscis and palpi yellowish.

Thorax grey with two definite broad central stripes and two indefinite lateral ones which extend from the hind margin to three-fourths the distance to the anterior margin; furnished with two rows of dorso-central, 3 pre-alar, 1 inter-alar and 2 supra-alar bristles, all of which are black and weakly developed; scutellum grey and bearing two marginal bristles.

Abdomen brownish, segments 1-6 largely silvery pollinose; venter dark grey to blackish; genitalia yellowish.

Legs yellow-brown, apices of tibiae and tarsi black.

Wings very slightly tinged brown, but otherwise without markings; cell M3 open.

The unique Holotype male is in G. H. Hardy's collection and is in good condition. The label gives the following data:—Hobart, 30/11/'13, G. H. Hardy.

PSILOCEPHALA NUDIFEMORATA.

Thereva nudifemorata Macquart, Dipt. Exot. Suppl. 1, 103, 1846.

Psilocephala nudifemorata White, Proc. Roy. Soc. Tasm., 1915. *Id.*, Mann, Aust. Zool., 193, 1928.

^{*} Aust. Zool., vol. vi., 21-22, fig. 2, August, 1929.

This species, described from Tasmania, has not been recognised. In 1915, White noted that "this species, described by Macquart under the name *Thereva nudifemorata*, is known to me; von Kroker states that it belongs to the genus *Psilocephala*, and I place it here on his authority."

The black antennae, together with the white and brown front, red legs and yellowish wings should readily distinguish this from all other known members of the genus.

PSILOCEPHALA VENUSTA.

Thereva venusta Erichson, Arch. V. Nat., viii., 1, 272, 1842.

Psilocephala venusta Kroker, Ent. Mitt. 1, 285, 1912. *Id.*, White, Proc. Roy. Soc. Tasm., 1915. *Id.*, Mann, Aust. Zool., v., 193, 1928.

This species, described from Tasmania in 1842, has not been recognised, but Kroker states that the type is in the Berlin Zoological Museum. The bright orange antennae and banded wings should readily separate the species.

PSILOCEPHALA OCCULTA.

Psilocephala occulta White, Proc. Roy. Soc. Tasm., 1915; *Id.*, Mann, Aust. Zool., v., 194, 1928.

Described from one female taken at Bagdad (Tasmania), November 9, 1914. The wholly black antennae, front and thorax, together with the wings mottled black, should serve to separate the species.

PSILOCEPHALA RUFA.

Psilocephala rufa Kroker, Ent. Mitt. 1, 253, 1912; *Id.*, Mann, Aust. Zool., v., 194, 1928.

This species, described from a female from Sydney has not been recognised, but the dull orange antennae and abdomen, together with the bright orange legs should serve to distinguish same. The type is in the Hamburg Museum.

PSILOCEPHALA SAXATILIS.

Psilocephala saxatilis White, Proc. Roy. Soc. Tasm., 1915; *Id.*, Mann, Aust. Zool., v., 194, 1928.

Described from one pair taken at Bagdad Valley (Tasmania), January, 1912 and 1914. The furrowed eyes, the two-coloured antennae and the light brown thorax and legs should make this species easily recognised.

PSILOCEPHALA CURTA.

Psilocephala curta Kroker, Genera Insectorum, 148 Fascicule, 30, 1913.

Described from a male from Sydney by Kroker in 1913, but has not been recognised. The type is in the Berlin Zoological Museum.

PSILOCEPHALA LATERALIS.

Psilocephala lateralis Erisch. (original publication unknown to me); *Id.*, Kroker, Konowia Ztschr., f. syst. Insektenkde Bd., vii., 1928, heft. 2.

This species has not been recognised by the writer.

Genus ECTINORRHYNCHUS.

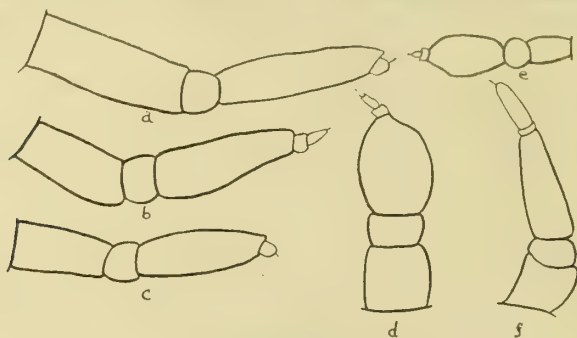
Ectinorrhynchus Macquart, Dipt. Exot., suppl. 4, 1850.

Since the publication of the first paper of this series two additional new species of the genus have been discovered, and these are both described herein. In consideration of the addition of these two new species it has been thought advisable to revise the key to facilitate determinations.

Revised Key to the Species of Ectinorrhynchus Macquart.

- | | |
|--|-----------------------------|
| 1. Slender species | 2. |
| Robust species | 3. |
| 2. Wings with three cross bands; antennae bright brown | <i>albimanus</i> Krober. |
| Wings with particularly indistinct bands | <i>levis</i> sp. nov. |
| 3. Wing bands distinct | 4. |
| Wing bands indistinct | 5. |
| 4. Antennae and scutellum bright orange | <i>brunneus</i> Krober. |
| Antennae dark brown; scutellum brownish black | <i>variabilis</i> Macquart. |
| 5. Antennae black; scutellum bright orange | <i>scutellus</i> sp. nov. |

Note.—It has been considered advisable to include Krober's *brunneus* in the above key. The species should be recognised by the description.*



Text Fig. 2.

- a. Antenna of *Ectinorrhynchus scutellus* sp. nov.
 b. Antenna of *Anabarrhynchus kosciuskoensis* sp. nov.
 c. Antenna of *Ectinorrhynchus levis* sp. nov.
 d. Antenna of *Eupsilocephala singula* Walker.
 e. Antenna of *Parapsilocephala wilsoni* sp. nov.
 f. Antenna of *Anabarrhynchus griseus* sp. nov.

ECTINORRHYNCHUS LEVIS sp. nov.

Length: 10-12 mm.

Male: Head with the occiput yellow and bearing black hairs and bristles in a row around the eye margins; eyes separated on the vertex by the width of the ocellar tubercle with the anterior margins straight for half the distance to the antennae and from thence convexly diverging; front yellow with an irregularly oval shining black median area immediately above the antennal tubercle; antennal tubercle shining black and covered with silvery tomentum; antennae brown, apical segment mainly black, hardly as long as the head and with the two basal segments beset with black hairs and bristles; segment 1 slightly broader than but scarcely as long as 3; 2 one-third the length of 1; 3 hardly as long as 1 and 2 together; the style is about one-third the length of the second antennal segment; the arista is about as long as the style; face and cheeks silvery white, the latter furnished with long fine whitish and yellowish hairs; proboscis dark brown

* Aust. Zool., vol. v., pt. ii., 157, May, 1928.

and projecting as far forward as the apex of the antennal tubercle; palpi light brown and two-thirds the length of the proboscis.

Thorax black-brown with two parallel longitudinal greyish stripes which coalesce on the basal third of the dorsum and form an irregularly rectangular patch; furnished with 3 pre-alar, 2 supra-alar and 2 pre-scutellar bristles, all of which are black and weakly developed; humeral calli and pleurae bright orange-brown; scutellum bright orange with the anterior margin slightly greyish, furnished with two marginal bristles; postscutellum greyish.

Abdomen dull black, covered with silvery white tomentum; segments 7 and 8, sides, venter and genitalia bright brown; segments 1-5 apically margined white.

Legs bright brown or bright yellowish brown, tarsi and apices of posterior tibiae black.

Wings tinged brown but hardly banded. The halteres are bright brown.

The female differs from the male, in addition to the usual sexual characters, in having the abdomen bright and yellow-brown throughout and in having segments 2-6 ornamented with black anterio-marginal spots. The genital spines are brown.

Holotype male and Allotype female, Swan River (West Australia), November (L. J. Newman) both in the Queensland Museum.

A somewhat aberrant species, having a head conforming more to the *Taenogera* type than the usual pyriform one of *Ectinorrhynchus*. It is closely allied to *variabilis* Macquart, but can be separated by the colour of the legs and scutellum.

ECTINORRHYNCHUS SCUTELLUS sp. nov.

Length: 10-12 mm.

Male: Head with the occiput yellowish centrally, but broadly shining black along the eye margins; eyes separated on the vertex by the width of the ocellar tubercle, with the anterior margins straight and parallel below this for half the distance to the antennae and then diverging, but still remaining more or less straight; front flattened, shining black; antennal tubercle shining black but silvery white towards the eye margins; antennae black, as long as the head; segment 1 slightly broader than but about as long as 3, furnished with numerous black bristles and hairs; 2 about one-sixth the length of 1 and likewise furnished with black bristles and hairs; 3 as long as 1 with a few black bristles and hairs at the base only; the tholiform, one segmented style is one-third the length of the second antennal segment; the sub-apical arista is almost as long as the style; face and cheeks silvery white, the latter bearing numerous long fine yellowish hairs; the buccal cavity is black; proboscis black and projecting as far forward as two-thirds the length of the first antennal segment; palpi yellow-brown, one-half the length of the proboscis.

Thorax black with two dull golden yellow, broad, convergent stripes which coalesce on the posterior third forming a rectangular patch; furnished with 3 pre-alar, 2 supra-alar and 4 pre-scutellar bristles, all of which are black, and, except for the pre-alar ones, are but weakly developed; pleurae dull black, with some yellow tomentum; scutellum bright orange and bearing four weakly developed marginal bristles; post-scutellum grey-black.

Abdomen orange, covered with shining silvery tomentum on the dorsum; venter orange; genitalia yellow-brown.

Legs orange; apical half of fore tibiae and basal half of first hind tarsus

yellowish, remaining tarsi and coxae all black; the hind femora bear a pair of apical bristles.

Wings tinged brown, forming two very indistinct cross bands; venation brown except along the fore margin which tends to yellowish. The halteres are brown.

The female differs from the male in having a slightly broader front, a longer and uniformly dark orange abdomen which, of course, is not covered with the silvery tomentum, and the banding of the wings slightly more distinct.

Holotype male and Allotype female, Bogong Plains (Victoria), January, 1928 (F. E. Wilson), have been returned to the collector.

Habitat: Bogong Plains (Victoria), 5,000 to 6,000 feet, one male and one female, January, 1928 (F. E. Wilson).

This species resembles *variabilis* Macquart, but can be distinguished by the colour of the legs, antennae and thorax. It is also closely allied to *brunneus* Krober, judging by Krober's description, but can be separated therefrom by the colour of the antennae.

EUPSILOCEPHALA SINGULA.

Thereva singula Walker, List. Dipt. Brit. Mus., 1, 227, 1848.

Eupsilocephala singula Krober, Ent. Mitt. 1, 255, 1912; *Id.*, Mann, Aust. Zool., v., 159, fig. 1, 1928.

Length: 10-12 mm.

Male: Head with the occiput shining black, furnished with numerous orange and reddish and black hairs and bristles; eyes separated on the vertex by the width of the ocellar tubercle with the anterior margins straight below this for half the distance to the antennae and from thence widely diverging; front shining black with a deep transverse median indentation; antennae orange, the two basal segments being darker than the apical and furnished with brownish hairs and bristles; segment 1 two-thirds the length of 3 about as broad as long; 2 slightly less than one-half the length of 1 and broader than long; 3 broadly conical (when viewed in profile) and as long as 1 and 2 together; style two-segmented as long as the second antennal segment and it has its first segment slightly shorter than its second; the arista is stout and slightly less than half the length of the style; face and cheeks silver-grey with black tomentum and the latter bearing numerous long fine black hairs; proboscis brown and projecting as far forward as half the length of the third antennal segment; palpi bright orange, very flattened and broad towards the extremity and almost as long as the proboscis.

Thorax shining black with purple and blue reflections, ornamented dorso-anteriorly with two yellowish stripes which extend from the anterior margin for one-fourth the length of the dorsal surface; furnished with 4 pre-alar, 3 supra-alar and 6 pre-scutellar bristles, all of which are orange and, all except the pre-alar ones, are but weakly developed, especially the pre-scutellar ones; pleurae black with purple reflections and furnished with four dark orange marginal bristles; post-scutellum black.

Abdomen shining black with purple, green and blue reflections intermingled; venter similarly coloured; genitalia brown.

Legs black, femora with purple reflections, tarsi yellow-brown; coxae bear scattered reddish bristles, the hind femora bear a pair of apical bristles which are dark orange and the tibiae bear numerous black and dark orange bristles.

Wings golden yellow with the tip largely brownish which colour ex-

tends from the apex of the median cell to the wing tip. The halteres are golden yellow.

The female differs from the male, in addition to the usual sexual characters, in having more green on the abdomen, paler coloured tarsi and more distinct thoracic stripes.

Allotype male, Chinchilla (Queensland), September, 1931 (J. Mann) in the Queensland Museum.

Habitat: West Australia (Walker's type locality), Mundaring, two females (J. Clark, no date); Chinchilla (Queensland), one male (the Allotype), September, 1931, and one female, September, 1930 (J. Mann).

Since the publication of the first paper of this series a further five specimens of this species, including the male, have been obtained. Reading over the description made in 1928 from one specimen from Tasmania, in the South Australian Museum, it is now considered that it did not truly represent the species but must have been either a variety or a closely allied one of the same genus. It has been thought advisable, in consequence of this, to give a redescription of the species, and there is no doubt now but that the five specimens referred to above truly represent the species as recognised by Walker and Krober.

This most beautiful Therevid is readily distinguished by the metallic colouration.

ANABARRHYNCHUS GRISEUS sp. nov.

Length: 8-10 mm.

Male: Head with the occiput grey with a deep median indentation and with weak black bristles arranged in two irregular rows; eyes separated on the vertex by slightly more than the width of the ocellar tubercle, anterior margins more or less straight; front yellow-brown on the vertical three-fourths and whitish on the remainder, median frontal spots absent, median longitudinal furrow distinct on the lower fourth only; antennae black separated at the base, apices of first segments convergent but not touching; segment 1 covered with grey tomentum and black bristles and hairs, slightly shorter than 3; 2 about one-third the length of 1 and likewise furnished with black bristles and hairs; 3 conical, slightly longer than 1 but not as long as 1 and 2 together; the style is almost half the length of segment 3 and has its first segment very short; the arista is short and stout; face and cheeks whitish, the latter bearing long fine similarly coloured hairs; proboscis black-brown; palpi brown and half the length of the proboscis.

Thorax brown and covered with black pubescence, ornamented with two broad, greyish, longitudinal, parallel stripes and furnished with 4 pre-alar, 3 supra-alar and 4 pre-scutellar bristles, all of which are black; pleurae grey, the nota- mesa- and metapleura each bearing a tuft of whitish hairs; scutellum grey with a median longitudinal brown stripe and bearing four marginal bristles; post-scutellum blackish.

Abdomen grey tomentose throughout, the first segment being a little darker than the others; venter greyish; genitalia brown.

Legs brown, femora greyish tomentose and the apices of the tibiae and tarsi black; the anterior femora are furnished with two apical black bristles and the posterior femora with one.

Wings tinged brown, yellowish along the fore margin, venation brown and very distinct; R4 slightly sinuose for two-thirds its length and then curving upwards to meet the wing margin well above the wing tip; Cul coalesces with 1A slightly before the margin. The halteres are grey with yellowish apices and margins.

The female differs from the male in the usual sexual characters only.

Holotype male and Allotype female, Geraldton (West Australia), September, 1926 (E. W. Ferguson), in the Council for Scientific and Industrial Research Museum at Canberra. Paratypes in G. H. Hardy's collection, Brisbane, and in the author's collection at Chinchilla.

Habitat: West Australia, as above, and three further males, Perth, November, 1912, one pair taken *in copula* (G. H. Hardy).

The pattern of the thorax, together with the general grey colour throughout, will readily distinguish this species from all other known members of the genus.

ANABARRHYNCHUS KOSCIUSKOENSIS sp. nov.

Length: 10-14 mm.

Male: Head with the occiput yellow-brown on the median vertical portion and greyish on the remainder, with a deep median indentation and beset with numerous black bristles which are not arranged in rows; eyes separated on the vertex by slightly more than the width of the ocellar tubercle with the anterior margins straight but angled at about one-third the distance from the vertex; front uniformly yellow-brown, thickly beset with black hairs and bristles, median frontal spots small and brown and widely separated and contiguous with the eye margins; antennae black, separated at the base with the apices of the first segments confluent; segment 1 greyish tomentose and furnished with numerous black bristles and hairs, two-thirds the length of 3; 2 with the apices somewhat whitish and furnished with numerous black bristles and hairs and about one-third the length of 1; 3 as long as 1 and 2 together and furnished with a few hairs only; the style is as long as the second antennal segment and has its first segment slightly less than one-half the length of its second; the arista is short and stout; face yellowish; cheeks whitish and bearing long fine similarly coloured hairs; proboscis brown and projecting as far forward as the apex of the first antennal segment; palpi yellowish and slightly more than one-half the length of the proboscis.

Thorax yellow-brown, darker brown dorsally and more yellowish laterally, with five brown parallel longitudinal stripes, the outer ones of which are fairly indistinct; furnished with 5 pre-alar, 3 supra-alar and 4 pre-scutellar bristles, all of which are black; pleurae grey with some yellowish tomentum; scutellum yellow-brown and bearing four marginal bristles; post-scutellum grey.

Abdomen stout, black, with segment 1 yellowish, 2 and 3 margined white and 1-6 greyish laterally; venter uniformly greyish; genitalia black.

Legs yellow-brown, coxae and apices of tarsi black; coxae furnished with tufts of hair and black bristles; fore femora with two apical bristles and intermediate and posterior femora with one apical bristle each.

Wings tinged greyish, but yellowish along the fore margin; venation yellowish; R4 decumbent for half its length and then curving upward to meet the wing margin slightly above the tip; M3 and M4 slightly convergent; Cul coalesces with 1A, which is straight, well before the wing border. The halteres are yellow.

The female differs from the male in the usual sexual characters only.

The Holotype male and Allotype female, Kosciusko (N.S.W.), December, 1922 (G. M. Goldfinch), in the C.S. & I.R. Museum at Canberra, together with a female paratype (same data); two female paratypes (same data) in the author's collection at Chinchilla.

Habitat: New South Wales, Mt. Kosciusko (one male and four females as above).

The species is closely allied to *calceatus* Schiner and *montanus* White, but the colour of the legs together with that of the front and thorax will serve to separate it from these. As, has been pointed out in Part 1 of these studies (Aust. Zool., vol. v., pt. ii., May, 1928) the species of *Anabarrhynchus* are very similar in general appearance and very few have any outstanding specific characters which would readily distinguish them from others of the genus. In view of this, determinations need to be carefully checked with the descriptions. The Key to the Species can be used only as a general guide. In the writer's collection upwards of a dozen undescribed species are represented. These will not be dealt with until such time as more specimens are available. It is quite probable that many collections of THEREVIDAE in Australia contain additional new species of the genus.

Genus PARAPSILOCEPHALA.

Parapsilocephala Krober, Ent. Mitt. 1, 255, 1912; *Id.* White, Proc. Roy. Soc. Tasm., 1915; *Oldenbergia* Krober, Ent. Mitt. 1, 220, 1912.

Small sized slender species with the head subhemispherical generally but sometimes somewhat pyriform, slightly broader than long and slightly broader than the thorax; occiput slightly or deeply concave and furnished with black bristles and hairs; eyes bare, large and in the males contiguous below the ocelli for some distance, and in the females widely separated; front mostly with a more or less prominent arch, the "frontal arch," above the antennae, but this is sometimes so small that it is discerned with difficulty; ocellar tubercle oval, raised and bearing tufts of hair; ocelli three in number and fairly widely separated; antennal tubercle mostly small; antennae generally shorter and never longer than the head and, in relation to the anterior margins of the eyes, they are inserted at about two-thirds their depth, they project forward and are composed of three primary segments, with a two-segmented style and an apical arista which is generally more or less stout; segment 1 stoutly cylindrical, 2 more or less globular and 3, when viewed in profile, broadly conical and longer than the first and second together; face and cheeks small, the latter bearing long fine grey or whitish hair; proboscis stout and generally well retracted into the buccal cavity, but sometimes projecting considerably; palpi two-segmented.

The thorax is slightly longer but deeper than broad, generally about twice as long as the head, more or less convex above, sometimes ornamented with stripes, and, in one species, with a metallic reflection and furnished with bristles in more or less regularity; scutellum semicircular and furnished, generally, with two marginal bristles; post-scutellum convex and always well hidden beneath the scutellum.

The abdomen is elongate-conical, flattened both dorsally and ventrally and with the segments often margined white, but is never silvery pollinose in the males; genitalia of the males small and retracted.

The legs are of normal length, the tibiae and tarsi being furnished with numerous bristles, but the femora mostly devoid of such.

The wings are of medium size, but in the females, owing to the elongate abdomen, they appear to be comparatively short; they are tinged grey or brown, and may have two or three cross bands. M3 and M4 always coalesce well before the wing border, thus, cell M3 is always closed; Cu1 and 1A join well before the wing margin; R4 joins the border well above the wing tip and is slightly sinuous only; M1 and M2 may arise very close together from the medium cell.

Genotype: *Parapsilocephala elegans* Krober.

Range: Australasia.

Distribution: Of the seven species described, one is confined to Victoria, one to Tasmania and two to North Queensland; one extends from Victoria to New South Wales, one from Victoria to Southern Queensland, and one from Tasmania, Victoria and New South Wales.

Krober proposed the genus in 1912 and distinguished it from *Psilocephala* by the presence of a "small but high arch of the frons above the antennae and by the third antennal joint being longer than the first and second together and broader than either of them." The examination of species of *Psilocephala* shows that in this genus a frontal arch may be present also and that the third antennal segment may be longer or, at any rate, as long as the first and second together. Further, in *Parapsilocephala* the frontal arch grades from very small to prominent. In consequence of this, as has been pointed out by White previously, it is necessary to further define the genus. From *Psilocephala* it can readily be distinguished by the absence of the silver pollen on the abdomen of the male, the more slender build, the elongate-conical abdomen, the small genitalia of the males and by the cell M3 always being closed.

Synonymy: White noted that "I think it doubtful, judging from von Krober's description, whether his genus *Oldenbergia* is really distinct from *Parapsilocephala*." In the material before me *Oldenbergia frontalis* Krober, is represented, and considering all of the characters I place this genus as a synonym.

Key to the Species of Parapsilocephala Krober.

1. Wings banded 5.
Wings not banded 2.
2. Thorax bright orange to wing bases; antennae velvet black with segment 1 orange; abdomen wholly black *bicolor* Krober.
Thorax otherwise coloured 3.
3. Abdomen mainly black or brown-black 4.
Abdomen and thorax dark brown; antennae black with segment 3 light brown *frontalis* Krober.
4. Sides of some of the abdominal segments orange; thorax grey-black with three stripes; antennae dark orange; legs orange and black *elegans* Krober.
Abdomen wholly black-brown; thorax brown with 2 stripes; antennae black; legs black and brown *wilsoni* sp. nov.
5. Wings with three cross bands; antennae shining black; thorax shining black with brown tomentum and a green reflection; legs black-brown, fore tibiae only of tibiae bright brown *parva* sp. nov.
Wings with 2 bands 6.
6. Thorax with grey silvery spot; legs dark brown with metatarsi of four hind legs about two-thirds whitish *albofasciata* Krober.
Thorax without spot; legs black, all tibiae yellow-brown *bifasciata* White.

Note: In the above Key the characters of *bicolor*, *albofasciata*, and *elegans* are taken from the original descriptions.

In the material before me I have four other new species which are represented by few or damaged specimens; these will not be described until more or better material is available.

PARAPSILOCEPHALA FRONTALIS.

Oldenbergia frontalis Krober, Ent. Mitt. 1, 221 and 284, 1912.

Length: 7 mm.

Female: Head pyriform with the occiput deeply concave, grey with two rows of weak black bristles around the eye margins; eyes separated on the vertex by twice the width of the ocellar tubercle with the anterior margins slightly convex and widely divergent; front black with yellow and grey tomentum and black hairs and bristles, with a median indentation and raised to a prominent frontal arch, the apex of which is shining black; antennal tubercle black, covered with white tomentum; antennae black with the apical segment light brown; segment 1, three times the length of 2 and 3, slightly longer than 1 and 2 together; the style has its first segment considerably broader but very little longer than its second; face and cheeks grey, the latter bearing long fine whitish hair; proboscis brown and projecting as far forward as the apex of the second antennal segment; palpi yellow-brown and two-thirds the length of the proboscis.

The thorax is dark brown, grey anteriorly and laterally and with four dark brown longitudinal dorsal stripes, the centre ones of which coalesce two-thirds of the distance from the anterior margin and continue as one stripe to the posterior margin; furnished with 3 pre-alar, 1 inter-alar and 1 supra-alar bristles, all of which are black; pleurae divided into two colours, bright brown above and grey below; scutellum dark brown with two marginal bristles; post-scutellum brown.

The abdomen is dark brown, somewhat shining, with segments 1-5 bright brown laterally; venter yellow-brown; genital spines brown.

Legs brown, anterior femora darker above, apices of tibiae and tarsi black; femora without bristles.

Wings tinged brown; M1 and M2 may arise very close together from the anterior corner of the median cell, or they may be separated at their origin. The halteres are yellow.

Variations: The front may be somewhat silvery near the eye margins.

The male is unknown.

Habitat: Woy Woy (New South Wales), 3 ♀, September, 1923 (I. M. Mackerras); Kiata (Victoria), 1 ♀, October, 1928 (F. E. Wilson).

Krober described this species from females taken in Sydney (New South Wales) and because of the high frontal arch he proposed for it the genus *Oldenbergia*. In consequence of the fact that, in *Parapsilocephala* there is a complete gradation of this character, it is considered by the writer that the former genus cannot be maintained.

PARAPSILOCEPHALA BICOLOR.

Parapsilocephala bicolor Krober, Ent. Mitt., xvii., 37, 38, fig. 7, January, 1928.

This species is not represented in the material before me, but the characters given in the Key should serve to separate it from all the others. The coloration of the thorax is unique.

The type female was taken by J. Dodd at Herberton, North Queensland, and is in the Dtsch. Ent. Museum, Dahlem.

PARAPSILOCEPHALA ELEGANS.

Parapsilocephala elegans Krober, Ent. Mitt. 1, 256, 285, 1912; *Id.* White, Proc. Roy. Soc. Tasm., 1915.

White records this species from Bagdad Valley and Brighton (Tasmania), and from New South Wales, Victoria and South Australia. Krober described both sexes from Sydney, and the type female is in the Hamburg Museum, and the type male in the Berlin Zoological Museum. Specimens are not included in the material before the writer, but the characters given in the Key should be sufficient to separate the species.

PARAPSILOCEPHALA WILSONI sp. nov.

Length: 5-7 mm.

Male: Head subhemispherical; occiput concave, brownish vertically and greyish laterally and furnished with an irregular marginal row of black bristles; eyes separated on the vertex by the width of the ocellar tubercle, but contiguous below this for two-thirds the distance to the antennae and from thence convexly diverging; front shining black with grey tomentum on the sides; frontal arch very small; antennae black with the apical segment somewhat brown at the base; segment 1 slightly less than twice the length of 2 and furnished with black hairs and bristles; 3 as long as 1 and 2 together and broader than either; style almost as long as the second antennal segment and with its first segment longer and broader than its second; antennal tubercle very small; face and cheeks grey, the latter bearing long fine grey hair; proboscis black-brown, long and projecting beyond the apex of the antennae; palpi black-brown and slightly less than half the length of the proboscis.

Thorax brown with two broad, yellowish longitudinal dorsal stripes which are interrupted and somewhat irregular on the posterior third; furnished with 3 pre-alar, 1 supra-alar, 1 post-alar and 4 pre-scutellar bristles; pleurae grey; scutellum brown with yellowish tomentum and bearing two marginal bristles; post-scutellum brown.

Abdomen black-brown, segments 7 and 8 reddish and 1-4 apically margined white; venter black-brown with brown margins; genitalia light brown.

Legs black; apices of fore femora, basal two-thirds of all tibiae and base of first tarsal segment on all legs, brown. The hind femora are furnished with three weak ventral bristles.

Wings brown tinged; cell M3 longer but narrower than the median cell. The halteres are yellow.

The female differs from the male, in addition to the usual sexual characters, in having the brown of the legs of a considerably darker shade.

Holotype male and allotype female, Kiata (Victoria), October, 1928 (F. E. Wilson), both returned to the collector, together with a female paratype of same data. A male and female paratype (same data) in the author's collection.

Habitat: Kiata (Victoria), 2 ♂ and 3 ♀ as above.

Named in honour of the collector. The colour of the thorax and legs will readily separate the species from other members of the genus.

PARAPSILOCEPHALA PARVA sp. nov.

Length: 4-5 mm.

Male: Head subhemispherical with the occiput deeply concave, grey with brown tomentum and fringed with black hairs and bristles; eyes separated on the vertex by the ocellar tubercle and from thence contiguous for two-thirds the distance to the antennae, after which they are concavely divergent; front dull black; frontal arch small; antennae shining black, segment 1 twice the length of 2, 3 almost three times the length of 1; the style is longer than the second antennal segment and has its first segment longer and broader than its second; antennal tubercle small and grey tomentose; face and cheeks black with grey tomentum and the latter bearing long fine grey hair; proboscis black and retracted into the buccal cavity; palpi black and two-thirds the length of the proboscis.

Thorax shining black, brown tomentose on the anterior and lateral dorsal margins and with a green reflection on the dorsum; furnished with 5

pre-alar, 1 inter-alar and 4 pre-scutellar bristles, all of which are black; pleurae and scutellum shining black, the latter with two black marginal bristles; post-scutellum dull black.

Abdomen shining black; segments 2-4 apically margined white; venter black; genitalia light brown.

Legs black-brown, fore tibiae and base of first tarsal segment on fore and middle legs, bright brown.

Wings with three distinct dark brown cross bands; cell M3 considerably longer and narrower than the median cell. The halteres are yellow.

The female differs from the male, in addition to the usual sexual characters, in having black-brown antennae and the brown of the legs of a considerably lighter shade.

Holotype male, Kiata (Victoria), October, 1928 (F. E. Wilson), returned to the collector. Allotype female, Brisbane (Queensland), November, 1928 (G. H. Hardy), in the Queensland Museum, and one paratype female, Brisbane (Queensland), November, 1928 (G. H. Hardy), in the author's collection.

Habitat: Victoria and Queensland, as above.

The wings with the three cross bands will readily distinguish the species. This is probably the undescribed Victorian species, with three cross bands on the wing, mentioned by White in a footnote to his description of *Parapsilocephala bifasciata* White.

PARAPSILOCEPHALA ALBOFASCIATA.

Parapsilocephala albofasciata Krober, Ent. Mitt., xvii., 38, 39, fig. 8, January, 1928.

Krober described both sexes from Palmerston (North Queensland) and lodged the types in the Dtsch. Ent. Mus. Dahlem. The characters incorporated in the Key to the Species should be sufficient to separate the species.

PARAPSILOCEPHALA BIFASCIATA.

Parapsilocephala bifasciata White, Proc. Roy. Soc. Tasm., fig. 25, 1915.

Length: 6 mm.

Female: Head subhemispherical; occiput slightly concave, brownish and furnished with numerous black hairs and bristles; eyes separated on the vertex by fully twice the width of the ocellar tubercle, with the anterior margins slightly convex and slightly divergent; front shining black, almost bare; frontal arch not very prominent, shining brown with dull black apex; antennae yellow-brown, the apical segment somewhat darker than the basal two; segment 1 with black hairs and bristles and twice the length of 2; 3 somewhat more than twice the length of 1, devoid of bristles but black haired at the base; style and arista both short and about equal in length; antennal tubercle greyish tomentose; face and cheeks grey, the latter bearing long fine whitish hairs; proboscis black, short, lying close against the face in the buccal cavity; palpi yellowish brown and two-thirds the length of the proboscis.

Thorax shining black with two very indistinct greyish stripes; pleurae black with grey tomentum; scutellum black with two black marginal bristles; post-scutellum grey-black.

Abdomen black, segments 2-3 apically margined white and both largely bright brown laterally; venter black; genital spines bright brown.

Legs black; tibiae, with exception of apices, apices of femora and first tarsal segment of all legs, yellow-brown; femora without bristles.

Wings tinged greyish with two broad brown cross bands; median cell longer and broader than M3. The halteres are brown.

Habitat: Hobart (Tasmania), 1 ♀, November, 1916 (G. H. Hardy).

White described both sexes from Bagdad Valley (Tasmania). The species can be distinguished by the banded wings in conjunction with the colour of the abdomen and legs.

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Errata.

I wish to call attention to and correct the following additional errors which have been found in the first part of this series of studies.*

p. 175.—In Key to the Species of *Anabarrhynchus*, lines 23 and 24 should read:—11. Thorax with three broad dark brown, more or less distinct stripes . . . 12 and thorax with five stripes, which, in comparison, etc.

p. 191, line 6, "scutellum brown," etc., to end of line should follow after "base only" in line 15.

p. 191, line 15, "the style is," etc., to end of line should follow after "bristles" in line 6.

p. 191, last line but one, for *calceatus* read *validus* sp. nov.

p. 192, line 41, read 1838 for 1830.

p. 192, line 42, read 1910 for 1920.

* Aust. Zool., vol. v., pt. 2, May, 1928.

A NEW LORICATE FROM NORTH QUEENSLAND.

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(Plate xviii.)

During exceptionally low tides in September, 1931, the area outside the shark fence at Alma Bay, Magnetic Island, North Queensland, was examined for loricates. Amongst a number of specimens were some which appeared to be juveniles of *Onithochiton quercinus* Gould. More critical examination later established the fact that they differed from *O. quercinus* in the possession of a scaly girdle and a distinctive radula, together with modified insertion plates. It is necessary therefore to introduce a new genus for their reception.

Order LORICATA Schumacher, 1817.

Family CHITONIDAE.

Genus ONITHELLA *gen. nov.* Type *O. helenae* *sp. nov.*

Definition, shells small, elevated, subcarinate, of bright colouring, general features as in *Onithochiton*, but minute scales replace spicules in girdle, insertion plates short, being faintly striate in head valve, smooth in median valves, and replaced by callus in tail valve, radula distinctive from *Onithochiton*.

In *Onithochiton* Gray, 1847, the insertion plates are long and deeply pectinate in head and median valves. The girdle armament consists of spines (*vide infra*).

The proposed new genus differs from *Lucilina* Dall, 1881, in its depressed tail valve, with replacement of insertion plate by callus, in girdle armament, and in its insertion plates.

ONITHELLA HELENÆ *sp. nov.*

Type and paratype in National Museum, Melbourne.

Shell small, narrow oval, elevated, subcarinate, slightly beaked.

Colour rose pink, flecked with white, tail valve edged in black (type), others rose or amber, flecked with white and with black markings on valves 2 and 8.

Head valve smooth and unsculptured, except eight or nine ill-defined scanty radial rows of large ocelli.

Median valves, lateral areas raised and smooth, except for faint radial depression, in which lies a scanty row of ocelli. Older shells show concentric growth line. Pleural area is sculptured in its posterior portion, with five to eight longitudinal sulcations, which become shorter as they approach the jugum. The jugal area is smooth and terminates posteriorly in a short beak.

Tail valve small, triangular, depressed, mucro terminal.

Postmucronal area represented by a small ridge with a single row of ocelli. Antemucronal area sculptured faintly as in pleural areas of median valves.

Girdle relatively narrow. Covered with minute elongate striated scales (about 20μ wide) amongst which may be seen an occasional slender spicule.

Interior pink. Slits 8-1-0. Insertion plates short, faintly pectinate in head valve, smooth in median valves, replaced by callus in tail valve. Sutural laminae small. Jugal sinus deep. Laminae united by barely visible coarsely toothed bridge.

Fig. 15a. Two teeth from the head valve of *Onithochiton quercinus* Gould, seen from the interior, x 40.



Fig. 15a.

Fig. 15b. Two teeth from the head valve of *Onithella helenae*, seen from the interior, x 40.

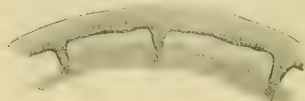


Fig. 15b.

Fig. 16a. Lateral margin of valve iv. of *Onithochiton quercinus* Gould, seen from interior, x 40.

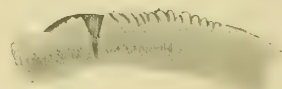


Fig. 16a.

Fig. 16b. Lateral margin of valve iv. of *Onithella helenae*, seen from interior, x 40.

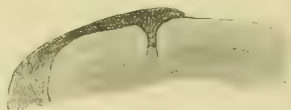


Fig. 16b.

Note.—Both shells were 9 mm. in length. In each case the valve was placed with the plates in the horizontal plane so that the teeth are viewed from the same angle in each figure. In *O. quercinus* the teeth are long and so deeply pectinated that each plate ends in needle points. The tegmentum is just visible at intervals. In *O. helenae* the teeth are short and smooth at the apex. The obsolete pectination which is present on the external surface is not visible. The tegmentum everywhere heavily overlaps the articulamentum.

Radula distinctive from that of *O. quercinus* notably in shape of second lateral.

Station: Under small stones fixed between granite boulders below low water at lowest tides.

Habitat: North Queensland coast from Fantome Island, Palm Group, to South Keppel Island, Keppel Bay. Type locality: Alma Bay, Magnetic Island.

Dimensions: Type 10 mm., maximum 11 mm.

Remarks: Similarity to *Onithochiton ashbyi* Bed. & Matt. led to critical examination of the latter. This reveals that the supposed horny girdle is also covered with minute striated scales of similar appearance, but one-third the size (width about $6-7\mu$). The insertion plates and radula of *O. ashbyi* agree with that of the new shell, and therefore *O. ashbyi* should be classed in genus *Onithella*.

The common Australian *Onithochiton* is *O. quercinus* Gould, in the synonymy of which we may include *O. scholvienei* Thiele and *O. rugulosus* Pilsbry.* The girdle of this species consists of fine spines, which are normally separated in the fully spread girdle. In shrunken specimens the spines appear to be closely set, and they are usually figured thus. Three kinds of spinous processes are present.

* Iredale and Hull followed this course in their Monograph.

1. Slender curved delicate glassy spicules scattered sparsely over the surface.

2. Thicker tapering glassy spines with faint longitudinal striation, both clear and amber coloured.

3. Milky white bottle shaped spines, with slightly curved glassy transparent necks, ending in a sharp point and not striated.

The girdle is thickly set with 2 and 3, which commonly occur in groups, giving a banded or mottled appearance. The milky whiteness becomes granular and opaque to transmitted light.

Study of growth stages shows that the youngest spines are striated at the apices, suggesting that spines have been evolved from scales.

In *Onithella* the scales persist, although scattered and non-imbricate. In *Onithochiton* and *Lucilina* they develop into spicules.

This shell is named in honour of the author's wife, in partial acknowledgment of her enthusiastic help.

Note on the Radula.

In the conventional figuring of one-half of a radular row (Figs. 14 a, b, c, d), the three genera *Onithochiton*, *Lucilina* and *Onithella* appear to have the common feature of a second lateral tooth with four cusps. When viewed from this angle there appears to be little difference between the four species figured as regards the second lateral.

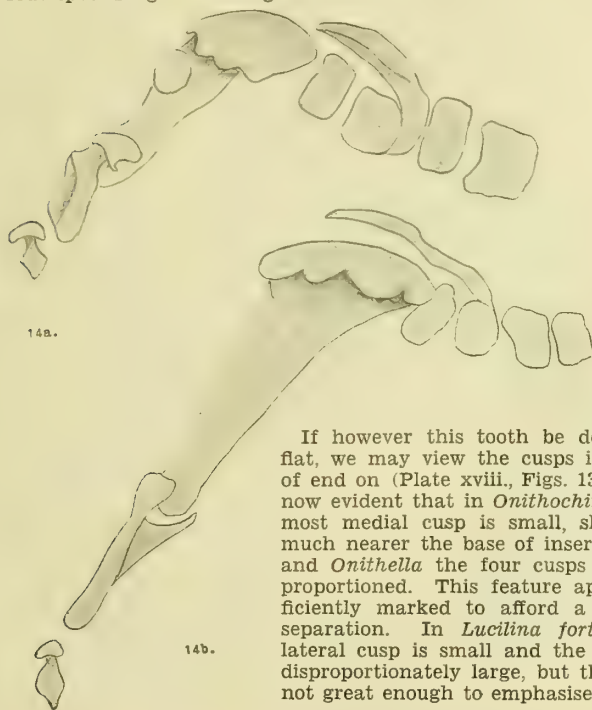


Fig. 14a. Half a radular row of *Onithochiton quercinus* Gould, x 110.

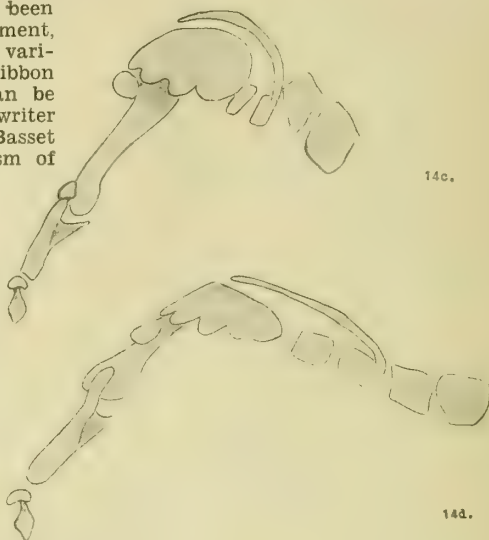
Fig. 14b. Half a radular row of *Lucilina fortilirata* Reeve, x 225.

If however this tooth be detached and laid flat, we may view the cusps in outline instead of end on (Plate xviii, Figs. 13a, b, c, d). It is now evident that in *Onithochiton quercinus* the most medial cusp is small, sharp, and placed much nearer the base of insertion. In *Lucilina* and *Onithella* the four cusps are more evenly proportioned. This feature appears to be sufficiently marked to afford a ready means of separation. In *Lucilina fortilirata* the most lateral cusp is small and the two central ones disproportionately large, but the differences are not great enough to emphasise at present.

Some differences have been noted in the minor armament, but as these are somewhat variable in the same radular ribbon no certain distinctions can be drawn at present. The writer is indebted to Mr. A. F. Basset Hull for a helpful criticism of the note on the radula.

Fig. 14c. Half a radular row of *Onithella helenae*, x 225.

Fig. 14d. Half a radular row of *Onithella ashbyi* Bed. & Matt., x 225.



Explanation of Plate xviii.

- Fig. 1. *Onithella helenae*. Whole shell x 9 (type).
- " 2. *Onithella helenae*. Head valve from above x 13 (paratype).
- " 3. *Onithella helenae*. Head valve from side x 13 (paratype).
- " 4. *Onithella helenae*. Head valve interior x 13 (paratype).
- " 5. *Onithella helenae*. Median valve (5) from above x 13 (paratype).
- " 6. *Onithella helenae*. Median valve (5) interior x 13 (paratype).
- " 7. *Onithella helenae*. Tail valve from above x 13 (paratype).
- " 8. *Onithella helenae*. Tail valve from side x 13 (paratype).
- " 9. *Onithella helenae*. Tail valve interior x 13 (paratype).
- " 10. *Onithella helenae*. Girdle scales x 480 (approx.) (paratype).
- " 11. *Onithochiton quercinus* Gould. Girdle spines x 77 (approx.).
- " 12. a, b, c. *Onithochiton quercinus* Gould. Girdle spines x 480 (approx.).
- " 13a. *Onithochiton quercinus* Gould. Second lateral tooth of radula detached and laid flat.
- " 13b. *Onithella helenae* Gould. Second lateral tooth of radula detached and laid flat.
- " 13c. *Lucilina fortilirata* Reeve. Second lateral tooth of radula detached and laid flat.

(In Figs. 13a, b., and c. the midline is towards the left.)

The writer is indebted to Miss Joyce K. Allan, of the Australian Museum, for a beautiful drawing of the type. (Figs. 2-13 by author.)

(Figs. 11 and 12 drawn from juvenile of 13 mm. length.)



ONITHELLA HELENÆ Mackay.

90.594-7

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A. F. BASSET HULL, C.F.A.O.U., F.R.Z.S.

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Royal Zoological Society of New South Wales.

ANNUAL MEETING, 1932-33.

The annual meeting of the Society was held at Science House, Sydney, on Friday, 28th July, 1933, at 8 p.m., eighty members and visitors being present. The Honorary Secretary (Mr. Basset Hull) read the

FIFTY-THIRD ANNUAL REPORT.

Members.

On 30th June, 1933, there were 516 members on the register, divided into the various categories, as follows:—Associate benefactors 3, life members 24, ordinary members 250, honorary members 8, honorary associates 5, life associates 24, and associates 202. Six members died during the year, 26 resigned, and 67 were removed from the register, under article 9. One hundred and fifteen new members and associates were elected, showing a net increase of 18 members and associates, as compared with 1931-32. While the depression may be blamed for so many dropping out of the ranks (and many were unfinancial at the end of last year, but held over for action), the net increase may be credited to the turn in the tide of prosperity.

Death of Prominent Members.

Miss Emily Hume-Barbour, the originator and first president of the Women's Auxiliary, and an associate benefactor, died on 29th July, 1932. Dr. W. D. K. MacGillivray, a life associate, and one of the foremost ornithologists in Australia, died in June, 1933. The loss of these two earnest workers in different spheres of energy directed towards the furtherance of the Society's objects will be keenly felt.

The Council.

During the year, Mr. A. H. Chisholm resigned his seat on the Council in consequence of his departure from the State. Dr. E. A. D'Ombraïn, who had previously been a member of Council but had retired temporarily, was elected to fill the vacancy. Ten meetings of the Council were held during the year, the average attendance at which was 13.3 members.

Finances.

The removal to the new room, the ever-increasing size of *The Australian Zoologist*, and the publication of the *Bibliography of Australian Entomology* have put an unusual strain upon our resources. The returns from the sale of the *Bibliography*, it is anticipated, will eventually recoup the funds.

Fellows.

The title of "Fellow" was conferred by the Council on Mr. Anthony Musgrave in recognition of his distinguished services to Australian zoology in the compilation of his *Bibliography of Australian Entomology*. There are now eleven Fellows of the Society.

Sections.

An addition was made to our Sections during the year by the formation of a Budgerigar Club, the activities of which are to be directed towards improving the knowledge of breeding colour varieties of this beautiful little

SEP 2 1933

parrot. Attendances at the meetings of the other three Sections have been kept well up to standard, and many interesting addresses have been given.

Avicultural Exhibition.

The Avicultural Section organised a Bird Parade, which was held from the 15th to 17th February, 1933, in the Blaxland Galleries, kindly placed at the Society's disposal by Farmer & Co., Ltd. No charge was made for admission, but special donations and the sale of catalogues resulted in a most successful function at a small profit to the Society. It was estimated that during the three days the exhibition was open more than 10,000 visitors attended. A full report of the function appeared in *The Australian Zoologist*, Vol. 7, page 4.

Alteration to Rates of Subscription.

The Council for some time has felt that the privileges conferred upon members were out of proportion to the comparatively small subscription. Further, that the official journal of the Society, being largely technical, was not appreciated by members whose interest was centred in the access to Taronga Park. A special general meeting of members was therefore called, and it was then decided to reduce the subscription to ordinary members from 21/- to £1, and to associate members from 7/6 to 5/-, but to discontinue the gratuitous issue of *The Australian Zoologist*. Provision, however, was made for a charge of 2/6 per annum as a subscription to this journal and the resulting saving in the printing and postage, it is estimated, will more than balance the slight loss from the reduction of subscriptions. Furthermore, the reduced subscription for associates will doubtless be followed by a large accession of new members from the ranks of the younger students.

Removal to New Room.

For some time past it was felt that our room on the first floor of Bull's Chambers was inconveniently crowded at many of the sectional meetings. Advantage was taken of an opportunity to remove to a larger room in the same building and more conveniently situated on the ground floor. This room is capable of seating 80 members. Improvements have also been made in the arrangements for screening lantern slides, cinematograph and epidiascope projections.

National Park.

The Trustees of National Park thought fit to determine the Society's occupation of the Gundamaian cottage which was required for the use of the Trustees themselves. The Society's furniture was therefore removed to the cabin at Waterfall, the occupation of which remains as hitherto a gift to the Society. A good deal of valuable work has been carried on in the observation and photographing of birds in National Park, the cabin being used as the centre of activity.

Honorary Members.

Dr. C. Davies Sherborn was elected an honorary member in recognition of his valuable services to the cause of zoology generally in the compilation of his monumental *Index Animalium*. Mr. Robert Buchanan, Honorary Ranger, residing at National Park, was elected an honorary member on the 31st May, 1933, in recognition of his personal services to members occupying the Gundamaian cottage.

Publications.

One of the most ambitious works published by the Society was Mr. Musgrave's *Bibliography of Australian Entomology*. The cost of this elaborate compilation was defrayed out of the Society's general fund, it being considered of too technical a nature to come under the purview of the Handbook Publication Fund. The cost has already been substantially recouped by contributions from other scientific institutions, and the sale of copies to the general public. The price (10/-) was based purely on the cost of production, and the Society does not look for any profit, being satisfied if the initial cost is defrayed.

Although not issued by the Society, the following works may be mentioned in this report as being produced by members of the Society:—

Mr. N. W. Cayley's "Australian Finches in Bush and Aviary," written and illustrated by himself. Dr. G. A. Waterhouse's "What Butterfly is That," illustrated by Mr. Cayley. Mr. T. C. Roughley's "The Cult of the Goldfish," and Mr. H. J. Carter's "Gulliver in the Bush." All published by that enterprising firm, Angus & Robertson, Ltd., Sydney, they will be found to fill each a long-felt want in its own particular sphere.

Fauna Protection.

Several instances occurred during the course of the year in which the Society was called upon to take active participation in the protection of birds or animals, not only in this State, but also in other Australian States. It is gratifying to find that whenever any case requiring investigation arises, this Society appears to be naturally consulted, and its support cordially welcomed.

The Chief Secretary Moves Adoption of Report.

The Hon. Frank Chaffey, M.L.A., Chief Secretary, in moving the adoption of the report and balance sheet, congratulated the Society on the result of its year's work, which he considered a pretty good effort. He suggested that there was an opportunity for worthy persons to come forward and fill the seventy vacancies in the ranks of ordinary members. The existence of such a Society fostered a keen interest in our native fauna, and its publications furnished the results of study. The Handbook Publication Fund, standing at £1,000, was still a long way from the objective of £5,000, and there was certainly room for donors to bring the fund up to the required amount. He referred to the loss sustained by the Society in the departure of Mr. Chisholm for another State. His knowledge of our fauna and his natural gift for journalism had made his works of great value. He had visited the Bird Parade, and thought the display of such a beautiful variety, and blend of colours in the Budgerigars must stimulate many to follow on with this excellent work.

He said: "In my position as a responsible Minister of the Crown I am brought face to face with many problems of fauna protection. I have to strike a balance between those who wish to protect every kind of bird and animal, and those who wish to destroy pests, kill for food, or for sale. My duty is definitely to protect both birds and animals where possible, but I ask you to recognise the difficulties of the man on the land who has to fight against attacks upon his crops, his fences, and his improvements. Where any bird or animal increases in numbers so as to become a menace, a license is issued, permitting those affected to reduce the numbers of the pest within reasonable bounds, and to this extent destruction has to be

allowed. I am, however, strongly opposed to those who want to exploit our beautiful native fauna merely for purposes of personal gain; those who illegally destroy animals on private land, and the poisoner who incidentally causes the death of sheep and cattle. Against these we will press for the fullest penalties. In a recent case where a prosecution took place for illegal possession of skins, the skilful work of our police resulted in a salutary example to others. A very heavy penalty was imposed, and I hope this will show that my Department will be satisfied with no half measures in such cases of illegal practices and those against the popular interest. The wholesale buyer of illegally taken skins is most to blame, as if there were no buyers there would be no incentive to capture the protected animals.

"I have been interested to learn of the increase in native birds in many parts of the State, and attribute this to the work of the Society, the activity of the police, and the honorary rangers appointed under the Acts I administer, together with the outstanding influence of the Gould League of Bird Lovers, which instructs the younger minds, and inculcates in them the value of protection. There has been a marked decrease in the number of complaints regarding boys with pea-rifles in the metropolitan district. Some years ago they were not uncommon, but not one complaint has been lodged during the past twelve months. Perhaps a little may be due to the hard times and the want of ammunition, but education is no doubt the strongest factor. Finally, I may say that we will take the line of watching the traffic. If there are no purchasers there will be no trappers, and in relation to birds, when an opportunity presents itself, I hope to introduce legislation to control aviculturists by registration and license, so that the birds may be inspected and kept under proper conditions."

Mr. A. G. Hamilton, in seconding the motion, stated that during the past 22 years the names of 700,000 children had been entered on the register of the Gould League.

Retiring Members of Council.

The six members who retired under the provisions of article 22 were re-elected, viz.: Messrs. E. J. Bryce, W. W. Froggatt, A. S. Le Souef, A. Musgrave, E. F. Pollock, and Dr. E. A. D'Ombrian

Presidential Address.

The President (Mr. Neville W. Cayley) then delivered his address on "Australian Parrots." A vote of thanks, moved by Professor W. J. Dakin, was carried by acclamation.

Election of Officers, 1933-34.

At the Council meeting, held on 2nd August, 1933, the following officers were elected:—President, E. J. Bryce; Vice-Presidents, Neville W. Cayley, Tom Iredale, T. C. Roughley, and E. L. Troughton; Honorary Secretary, A. F. Basset Hull; Assistant Honorary Secretary, K. A. Hindwood; Honorary Treasurer, P. Shipway; Honorary Librarian, A. S. Le Souef.

BALANCE SHEET AS AT 30th JUNE, 1933.

HAND BOOK FUND INCOME ACCOUNT. Twelve Months ended 30th June, 1933.

RECEIPTS.			DISBURSEMENTS.		
	£	s. d.		£	s. d.
To Balance at 30th June, 1932:—			By Transfer to General		
„ Commonwealth			Account	60	0 0
„ Savings Bank of			„ Balance at 30th June, 1933:—		
„ Australia	94	19 6	„ Commonwealth		
„ Cash on Hand ..	13	7	„ Savings Bank of		
			„ Australia	81	9 11
„ Hand Book Sales ..		95 13 1	„ Cash on Hand ..	23	18 5
„ Interest on In-		7 3 0			
„ vestments		42 12 3		105	8 4
„ Donation, Walter					
„ and Eliza Hall					
„ Trust		20 0 0			
	£165	8 4		£165	8 4

GENERAL INCOME ACCOUNT.
Twelve Months ended 30th June, 1933.

RECEIPTS.					DISBURSEMENTS.				
	£	s.	d.			£	s.	d.	
To Balance at 30th June, 1932:—					By Publication—				
„ C'th Bank of					“Australian Zoologist”				
Australia	15	9	0		(Vol. 7, Parts 3 and 4)—				
„ C'th Savs. Bank					.. Printing	159	17	0	
of Australia ..	228	10	5		.. Blocks	19	7	9	
„ Cash on Hand ..	16	18	11		„ Postage and				
„ Cheques to be					Delivery	8	9	4	
re-presented ..	9	9	6						187 14 1
				270 7 10	„ Publication—				
„ Subscriptions —					Anthony Musgrave's “Biblio-				
Annual	333	9	0		graphy of Australian En-				
„ Subscriptions —					tomology” (including Sales				
Life	3	15	0		Tax, £15/16/6)	280	8	3	
				337 4 0	„ Office Rent	118	13	4	
„ Sales “Australian Zoologist”				5 13 0	„ Office Printing & Stationery	27	19	1	
„ Rent of Office				23 0 0	„ Expenses Meetings, Annual,				
„ Interest on Investments ..				21 2 5	etc.	8	10	0	
„ Bank Exchange & Postage ..				1 12 11	„ Gas and Electricity	11	5	1	
„ Sundries				11 8	„ Library Books			12 6	
„ Donations:—					„ Telephone	14	0	6	
Towards cost of publishing					„ Post Office Box Fee	1	0	0	
Anthony Musgrave's “Bib-					„ Insurance			2 12 0	
liography of Australian					„ Postages & Receipt Stamps	22	3	0	
Entomology”					„ Office Furniture	28	14	0	
Council for Scien-					„ Avicultural Section Exhibi-				
tific and Indus-					tion			4 0 0	
trial Research ..	10	0	0		„ Expenses on Account Annual				
Linnean Society ..	10	0	0		Dance	2	18	8	
Australian and					„ Removal to New Office .. .			4 10 0	
New Zealand					„ Wianamatta Shale Commit-				
Association ..	10	0	0		tee			1 0 0	
				30 0 0	„ Painting Cabin			2 4 2	
„ Sales Anthony Musgrave's					„ Stamp Duty on Lease			1 2 6	
“Bibliography of Australian					„ Framing Photograph			1 0 0	
Entomology”				34 10 0	„ Repairs Typewriter			1 0 0	
„ Avicultural Section Exhibi-					„ Balance at 30th June, 1933:—				
tion				6 8 6	C'th Bank of				
„ Annual Dance Proceeds on					Australia	45	17	0	
Account				4 5 0	C'th Savs. Bank				
„ Transfer from Hand Book					of Australia ..	13	19	4	
Fund				60 0 0	„ Cash on Hand ..	13	11	10	
									73 8 2
				£794 15 4					£794 15 4

I have examined the books and vouchers of the Royal Zoological Society of New South Wales for the twelve months ended 30th June, 1933, and certify that the above Balance Sheet and accompanying statements are properly drawn up so as to exhibit a true and correct view of the state of the Society's affairs as at 30th June, 1933, and the transactions for the year ended that date respectively as disclosed by the books of the Society and information supplied.

Sydney, 25th July, 1933.

(Sgd.) ROBT. J. STIFFE, F.C.A. (Aust.),
Hon. Auditor.

(Sgd.) PHILLIP SHIPWAY,
Hon. Treasurer.

REPORTS OF SECTIONS.

Ornithological Section.

The activities of this section during the past twelve months have been progressive. The average attendance for the ten functional meetings was 34, which was greater than in previous years, and is a good indication of the interest shown in the work of the section. A camp-out at Wamberal, in the Gosford district, was arranged in September, 1932; more than 20 members and friends were under canvas, and a delightful holiday was spent in sylvan surroundings. Birds were plentiful, and many of us had the pleasure of observing the habits of species that were "new" to us. Two other camps of shorter duration were held at the bird cabin, Waterfall, National Park. Apart from these organised field activities many members have camped in various localities studying the habits of particular birds.

We offer our heartiest congratulations to Neville W. Cayley on the publication, in September, 1932, of a second bird book, "Australian Finches in Bush and Aviary." This well-produced volume is illustrated in colour and half-tone, and contains a wealth of information for those interested in aviculture. Likewise, it makes available, in a concise manner, most of the published observations on the habits of these birds in the field, supplemented by Mr. Cayley's own notes.

Quite a number of papers, as well as lesser contributions to the science of ornithology from members of the section have appeared in the pages of "The Emu" during the year. A perusal of this journal will show that we are not lacking in vitality. The photographic side of bird-study is as good, as, if not better than, in the past.

The undermentioned meetings were held during the year:—

July 15th, 1932.—Neville W. Cayley: "Australia's Wonder Birds." Illustrated with splendid lantern slides from the photographs of well-known nature photographers.

August 19th, 1932.—Tom Iredale: "Extinct Birds." Illustrated with lantern slides of old and historic sketches, and illustrations, as well as photographs.

September 16th, 1932.—Michael Sharland: "Birds of S.E. Australia and Tasmania." Illustrated with an excellent series of lantern slides from photographs by the lecturer.

October 21st, 1932.—P. A. Gilbert: "Sidelights on Nature." An interesting lecture on various aspects of nature. Illustrated by lantern slides.

November 18th, 1932.—A. H. Chisholm: "Early Days in Victoria." The lecturer detailed his experiences with birds from the days when he was a boy till the time he left Victoria some fifteen years ago. Illustrated with lantern slides from photographs taken by Mr. Chisholm.

December 16th, 1932.—Social evening. Members and their friends were the guests of the chairman and vice-chairman of the section.

January 20th, 1932.—Tom Iredale: "Lord Howe Island." An illustrated address, describing the topography, flora and bird-life on the island. Mr. Iredale described his exploits as a mountain climber, proving his remarks with photographs, showing himself perched precariously on dizzy crags.

February 17th, 1933.—Anthony Musgrave: "A Naturalist in the Warrumbungles." This delightful and interesting lecture was illustrated with an artistic series of hand-coloured lantern slides.

March 17th, 1933.—A. F. Basset Hull: "Islands and Birds." The lecturer detailed his experiences with sea-birds inhabiting the many islands lying off the Australian coast. Illustrated with a fine series of lantern slides.

April 24th, 1933.—E. J. Bryce: "African Animals." A talk on many of the animals, and also the natives met by Mr. Bryce during a recent trip through Africa. Illustrated with lantern slides.

May 19th, 1933.—Because of the inclemency of the weather and the small attendance this lecture was adjourned until a future date.

June 16th, 1933.—Annual meeting. K. A. Hindwood: "The Green-backed Mangrove Heron." A talk on the habits of this species, illustrated with lantern slides.

K. A. HINDWOOD,
Chairman.

Marine Biological Section.

Report for the year ended June, 1933.

(Read at the Annual Meeting, June 6th, 1933.)

To-night's meeting marks the close of the seventh year of the Marine Section's activities. It has been a year of progress, and the greatest response has been made to the programmes provided by our science lecturers.

In each subject presented to the Section—in zoological and historical studies, economic developments, and the problems relating to conditions in the tropics, the Pacific, and the Antarctic, there is material which may be used to advantage.

At the May meeting, the development of extension work was promulgated by the appointment of a Committee for Fisheries and Fauna.

Thanks to the combined efforts of the various contributors, each an expert in his or her subject, to this Section's *Handbook of the Marine Fauna*, a stage has now been reached at which the material can be considered for publication. A thick parcel of manuscripts and many beautiful photographs and drawings has been compiled, and it is estimated that a well illustrated book of some three hundred pages will result. The Council of the Society having signified its approval, negotiations are now in hand to have this material published as soon as practicable. It is hoped that the *Handbook* members have been looking forward to and working upon for so long may become an accomplished fact.

Mr. D. J. Mares, Government Meteorologist, kindly co-operated with the Section in correlating weather conditions with unusual local occurrences of pelagic organisms. The Section has also formed a Fisheries Committee to study methods of Australian fisheries development and the Extension Committee, already referred to, to spread the knowledge gained from lectures to a wider educational field, more especially in view of the forthcoming Fisheries and Fauna Exhibition.

The following lectures were delivered during the year:—

North-West Islet, Queensland.—F. A. McNeill. 4 July, 1932.

Some Early Australian Naturalists.—A. Musgrave. 1 August, 1932.

Australia's Northern Boundary.—A. A. Livingstone. 5 September, 1932.

Not Quite Fishes.—G. P. Whitley. 4 October, 1932.

Marine Life of the Local Shore (General Discussion).—7 November, 1932.

- Goldfish in the Home.—T. C. Roughley. 5 December, 1932.
 The Octopus and its Allies.—Miss Joyce Allan. 6 February, 1933.
 Marine Mammals.—E. Le G. Troughton. 6 March, 1933.
 Experiences in New Guinea.—Melbourne Ward. 3 April, 1933.
 Sex in the Marine Environment.—A. N. Colefax. 1 May, 1933.

An innovation this year was the screening of Ciné-Kodak films depicting scenes on the Great Barrier Reef, Queensland, and at Lord Howe Island. The lectures and other features have been popularly received, so that good attendances have been maintained, and we have had the pleasure of welcoming many visitors. The larger new room of the Society offers improved accommodation, and this Section was the first to hold a meeting in it.

GILBERT P. WHITLEY, Chairman.

G. CHARTER SMITH, Honorary Secretary.

Avicultural Section.

Interest in the work of the Section has been portrayed by the increased attendances at the many meetings held throughout the year.

Prompted by the evergrowing and world-wide popularity of the Budgerigar as a cage bird, the Section deemed it advisable to stimulate interest in these beautiful birds by forming a sub-section with a view to fostering and encouraging them in this State. A separate executive was elected and arrangements made whereby special meetings of people so interested could be held each month.

As a result of discussion on the method of housing birds at Taronga Park, the Trustees requested the co-operation of this Section to assist in making improvements in the existing enclosures.

Your representatives, after visiting the Park and reviewing the aviaries, submitted a report embodying a number of suggestions. The report was favourably received by the Trustees, who intimated that as soon as funds were available the suggestions submitted would be acted upon.

After much correspondence with the Chief Secretary's Department, the Government representative at Darwin, and several licensed trappers, a satisfactory arrangement has been made to obtain 150 dozen finches and 16 dozen parrots for distribution amongst members. Part of the consignment has been received, and arrangements made for the remainder to arrive during the coming spring.

Thanks to the courtesy of Farmer & Co., Ltd., in placing their Blaxland Galleries at our disposal for three days, a wonderful display of cage birds was staged by members of this Section and the Budgerigar Section, under the patronage of the Lord Mayor of Sydney and the Honorable the Chief Secretary. The display created great public interest and success crowned their efforts. The donors of prizes, the exhibitors who were responsible for the staging of upwards of 600 birds, and the judges who awarded the prizes are also deserving of special mention, and I trust the result will be the means of spurring members on to greater efforts in the coming year.

Thanks are due to the numerous friends who rendered great assistance by delivering interesting and educational lectures at the monthly meetings. All members are enjoined to continue their support of this Section, and it is hoped that during the ensuing year further progress may be made, and

the aviculturalists of this State officially recognised and permitted to save for Australia many varieties of our feathered beauties from extinction by caring for and propagating of them in the safety of their aviaries.

E. W. JONES,
Honorary Secretary.

SYLLABUS OF SECTIONAL MEETINGS, SEPTEMBER TO DECEMBER, 1933.

Avicultural Section.

(Second Monday in the Month.)

11th September.—“Diseases and Ailments of Aviary Birds and Their Treatment,” by L. James.

9th October.—“In Quest of the Blue Bird of Paradise,” by J. Ward.

13th November.—“Birds in Taronga Park,” by C. Camp.

11th December.—“Pheasants and Pheasant-like Birds,” by Frank Buckle.

Budgerigar Club.

(Third Tuesday in the Month.)

19th September.

21st November.

17th October.

19th December.

(Discussion on Treatment and Colour-Breeding.)

Marine Zoological Section.

(First Monday in the Month, except when a public holiday; then on first Tuesday.)

4th September.—“Natural History Reminiscences,” by Dr. G. A. Waterhouse.

3rd October (Tuesday).—“Superstitions Regarding Animals,” by M. Ward.

6th November.—“Marine Divisions of Australian Fauna,” by T. Iredale.

4th December.—“Fisheries,” by A. N. Colefax.

Ornithological Section.

(Third Friday in the Month.)

15th September.—“Early Australian Ornithologists,” by G. P. Whitley.

20th October.—“A Naturalist on the Nepean,” by Anthony Musgrave.

17th November.—“Rambles of a Bird Observer,” by Michael Sharland.

15th December.—Social Evening—to be arranged.

Sectional Meetings are held in the Society's Room, 28 Martin Place, commencing at 7.30 p.m. Members and associates may bring friends.

New Members.

The following have been elected since publication of the last list (10th March, 1933):—Ordinary members: Miss S. George, Mrs. R. J. Martin, G. J. McPhee, R. L. Snelling, and I. A. H. Spain. Life associate: A. D. Thomas. Associates: T. S. Adams, C. Bellamy, Miss B. Buring, J. H. Brown, J. Clarke, E. S. Filewood, Miss M. R. Laurie, D. Leithhead, Miss G. Kennedy, J. Kennedy, V. Peters, Mrs. V. S. Raves, H. Relton, junior, Miss C. Sears, J. Sharpe, O. Vaughan, and H. O. Wilks.

AUSTRALIAN PARROTS.

PRESIDENTIAL ADDRESS.

By NEVILLE W. CAYLEY, F.R.Z.S.

Australia is a "Land of Parrots," and there is no exaggeration in such a statement, as parrots occur in Central and South America, tropical Africa and southern Asia, and throughout the Australian region, but nowhere are they more numerous or do they present greater diversity of form than in Australia.

As regards the "Land of Parrots," that "Terra Incognita," a rather vague land or lands of very early voyagers, one hesitates to air an opinion. Some credit the Dutch as having so named that part of the Australian coast visited by them in the early seventeenth century, but fail to give references.

However, a 1569 world map of Mercator has upon it a place called "Terra Psittacorum, The Land of Parrots." This is marked in 45 degrees south, away to the south-ward of the Cape of Good Hope. One presumes that Mercator drew his information from either Portuguese or Spanish sources. It may be that the name had something to do with Australia. It may be, on the other hand, that it was derived from the reports of the Portuguese that in a far southern land they had seen "popinjays of marvellous bigness." Whether that was over in South America, or in the East Indies or Australia it would be difficult to say. Other early map-makers carry the "Land of Parrots" still further to the south.

The earliest known original illustration of an Australian parrot was sketched by one of the artists on board the *Endeavour* during the first of the three famous voyages of Captain Cook.

After successfully observing the transit of Venus at Tahiti, Cook made for New Zealand waters and later sailed towards Australia. Cruising northwards along the east coast the *Endeavour* put in to Botany Bay for a few days (April 29th to May 7th, 1770). Many birds were taken as specimens, but only one was sketched at the time, and that by Sydney Parkinson. This historic pencil sketch is an outline of a female Banksian Black Cockatoo. Parkinson's drawings passed into the keeping of the British Museum in 1827, together with most of the invaluable manuscripts, specimens, drawings and the library of Sir Joseph Banks.

The second original illustration of an Australian parrot was painted during Cook's third and last voyage.. William Ellis, the artist, executed a water-colour drawing of the Tasmanian Green Rosella. This painting, dated 1777, is now preserved in the British Museum.

Descriptions and sometimes illustrations of the birds brought to England as the results of Cook's voyages appeared in several publications, such as Gmelin's *Systema Naturae*, Latham's *Synopsis*, and so on. The first illustration of an Australian parrot to appear in print was that of the Rainbow Lorikeet, published in Peter Brown's "New Illustrations of Zoology," 1774.

When the settlement of New South Wales began in 1788 the officers and men of the First Fleet were greatly interested in the strange wild life around them. Water-colour drawings were made of flowers and birds. In several collections of paintings dating from about this period we find many illustrations of parrots, including the rare Turquoise Parrot and also the Ground or Swamp Parrot.

The earliest publications detailing the life of Sydney Cove, as it was then called, contain coloured plates of parrots. In such books as Phillip's *Voyage* and White's Journal, *The Naturalist's Miscellany*, and other contemporary productions we see ample evidence of the interest shown in these beautifully coloured and attractive birds; as it was then, so it is to-day.

Since Captain Cook visited Australia, more than 160 years ago, parrots have attracted the attention of scientists, bird-lovers and tourists. As aviary birds they have always been extremely popular, for, apart from their beauty and elegance, they are easily kept and many species breed readily in captivity.

Why is it then, that birds in such demand should be so neglected as regards matters that really count? Many species await correct determination, and this also applies to certain genera and families. Are we content to follow the leader, instead of trying by concerted effort to arrive at definite conclusions? In the past, in numerous instances, any variation in colour, irrespective of range, has been deemed sufficient grounds for creating a new species; a dangerous procedure when applied to parrots which usually take several years to obtain full adult plumage.

As there still exists a considerable difference of opinion regarding the classification of Australian parrots there is much work to accomplish, and what better subjects present themselves to both the ornithologist and aviculturist than these beautiful birds? One may suggest that by the wholehearted co-operation of workers in ornithology and aviculture, the work ahead would be greatly expedited. Recent successes achieved in Australia in breeding in captivity of several species of the fast disappearing *Neophema* parrots is proof positive, that with scientific methods it is possible to breed any of our rarer parrots. One hears the disclaimer that birds bred under such circumstances would perish if liberated; no doubt this is so, but what alternative presents itself? It is far better to see these birds producing their kind in captivity than that they should become extinct. Unless a serious attempt is made to try and save the few species now on the verge of extinction it will be too late and they will pass away without our knowing anything of their life histories. Field knowledge in regard to even the common species of parrots is negligible, and the eggs of at least three species, *Geoffroyus geoffroyi*, *Opopsitta coxeni* and *Barnardius macgillivrayi* are as yet undescribed. As before stated, here is practically an unknown group of birds, and to those young enthusiasts keen to win their spurs in both sciences, one can do no more than hopefully commend Australia's parrots.

Sixteen years ago, Gregory M. Mathews published a comprehensive survey of the parrots, cockatoos, etc., of Australia. His grouping of the order was based upon a thorough examination of wide series of skins, and there can be little doubt that his classification should have taken the place of that in use at the time. Unfortunately, the majority of Australian workers have ignored Mathews's arrangement, despite its completeness. At the time, Mathews indicated certain lines of investigation and suggested that particular attention be paid by field workers in Australia to those species thought to be on the verge of extinction. Since then, however, very little has been added to our knowledge of these birds.

Many interesting problems present themselves, and the more one examines the group, the more fascinating the study becomes. Even a casual survey discloses several outstanding features. One is impressed

with their beauty, their diversity in colour, size and form. Another feature is the striking plumage pattern discernible and almost constant, in each family. Here let me explain that when referring to plumage pattern one does not include colour. Then one notices the extraordinary variation in the colour arrangement of species within a genus. Again, many species appear to have reached a stage of development, with a fixed colour pattern throughout their range, while several are still in a transitional stage as regards colour development. The following résumé of the group is based on Mathews's classification, reference being made to the Royal Australasian Ornithologists' Union Official Check List, 1926, where necessary.

The first family, *Trichoglossidae*, Lorickeets, includes 7 species, all of which are fairly common; in fact, most of them are on the unprotected list, owing to the havoc they cause to orchardists. Four genera are represented, *Trichoglossus* (two species, *T. moluccanus* and *T. rubritorquis*), *Eutelipsitta chlorolepidotus*, *Psittuteles versicolor*, and *Glossopsitta* (three species, *G. concinna*, *G. porphyrocephala* and *G. pusilla*). Each genus is distinctive as regards the plumage pattern, and one commends Mathews's addition of the genus *Eutelipsitta* in lieu of *Trichoglossus* for the scaly-breasted Lorickeet, *E. chlorolepidotus*. The family *Opopsitta*, Fig-parrots, has two representatives, *Opopsitta coxeni* and *O. leadbeateri*, of which very little is known. Both species appear to be extremely rare, though why this should be so is difficult to understand, their habitat being the coastal and contiguous scrubs of mid and north-eastern Australia, where large areas are as yet in a virgin state. These parrots show a close resemblance to the African Love-birds (*Agapornis*), which are rapidly becoming domesticated, being great favourites of aviculturists.

Strangely enough the eggs and nest of *O. leadbeateri*, the rarer of the two, are known, while those of *O. coxeni* still await discovery.

The next family, *Proboscigeridae*, is represented by a sub-species only, *Probosciger aterrimus macgillivrayi* (Mathews, 1912), which inhabits Cape York Peninsula. Its large bill and bare facial patches show a slight resemblance to the Macaws of tropical America, though it is not even distantly related to these birds. It lives well in captivity, and from recent evidence obtained should breed readily.

The family *Kakatoëidae*, Cockatoos, comprises 10 species, and these, with two exceptions, the White Cockatoo and Galah, both recognised pests, require rigid protection, for it is noticeable they are becoming rarer each year. Mathews divides the 10 species into 9 genera, while only 3 genera are admitted in the R.A.O. Official Check List, 1926.

Calyptrorhynchus banksi has a wide distribution and shows marked variations throughout its range; *Harrisornis lathamii* and *Zanda baudini* show little variation, while *Zanda funereus* is subject to xanthic aberration, especially on the head and sides of face.

Callocephalon fimbriatum is quite distinctive among all cockatoos in its plumage pattern and coloration, and shows little colour variation. Unfortunately it is becoming extremely rare, even in localities where once plentiful.

Kakatoë galerita is well known and common everywhere throughout its range.

Lophochroa leadbeateri has a plumage pattern very similar to the preceding species and shows little, if any, colour variation.

It is a handsome bird, perhaps the most beautiful of the cockatoos, and is by no means plentiful.

Ducorpsius sanguinea is a favourite aviary bird and is not as plentiful as one would wish it to be. It has little, if any, colour variation throughout its range.

Licmetis tenuirostris is another species popular with aviculturists, and also becoming rare in localities where once common. It shows little colour variation, except that in old birds the pink suffusion is deeper.

Eolophus roseicapillus is extremely common throughout the inland areas and is considered one of our worst avian pests. Its plumage pattern is distinctive with little colour variation.

The family *Leptolophidae* has one dainty representative, the Cockatiel, *Leptolophus hollandicus*. Its form, plumage pattern, and coloration is very different to other parrots, and throughout its extensive range only slight colour variation is noticeable in birds from north-western and northern Australia.

The family *Loriidae*, Lories, has two representatives: both are sub-species and of different genera.

Lorius pectoralis macgillivrayi is a beautiful parrot, and distinguished from *L. pectoralis* of the Aru Islands and New Guinea by its larger size, slimmness of form, and longer tail.

Geoffroyus geoffroyi macleannani is another form which differs from its New Guinea relatives—in this instance by its smaller size.

Both these parrots are found in the Pascoe River district, Cape York Peninsula, and are two of the most important discoveries made by the late Dr. W. D. K. MacGillivray and W. Macleannan.

The family *Polytelitidae* is represented by four genera. *Polytelis* has two species, *P. swainsoni* and *P. anthopeplus*, both beautiful birds, and both in need of strict protection, for they are nearing the danger line as regards numbers. These parrots are in great demand as aviary birds, but unfortunately are usually kept singly in small cages, no attempt being made to breed them. Though alike in form, their plumage pattern is different.

Spathopterus alexandrae is one of the most beautiful and graceful parrots in existence, with a plumage pattern and colouring quite different from other parrots. According to the late G. A. Heumann, C. Lienau, of South Australia, who kept and bred the species in captivity, found that the spatulate elongation of the third primary of the wing of the male which gives the species generic distinction, is acquired long after the bird has reached adult plumage. This species is also extremely rare and in grave danger of extinction.

Aprosmictus erythropterus is another beautiful species and fairly common. It has a distinct plumage pattern, and colour variations are noticeable in birds from the northern areas, which usually are brighter and generally smaller in size. As a cage bird it is in great demand.

Alisterus scapularis is a fine parrot and fairly common. Like the preceding species, birds from northern Queensland are brighter and slightly smaller in size. Its plumage pattern and coloration is distinctive and sufficient to separate it generically from *Aprosmictus*.

The family *Platycercidae*, Broad-tailed parrots, is a large one and includes 10 genera.

Platycercus, of which 8 species are recognised, are all beautiful parrots and all fairly plentiful. It is with these medium platycercine parrots that one notices the importance of the plumage pattern irrespective of the colour arrangement. In all the species the same pattern design in the

plumage of both immature and adult birds is constant, and, while adults show a marked variation in the colour distribution, there is a striking similarity in the colouring of all immatures.

It appears from the evidence available, that all these species evolved from a common form, a green bird, more than likely, the Green Rosella, *Pl. caledonicus*, of Tasmania. This is one of the intriguing problems that require further elucidation, and one where the co-operation of both ornithologist and aviculturist would prove most helpful.

The first species, *Pl. elegans*, has a wide distribution, extending from Kangaroo Island to Northern Queensland, and also occurs on Norfolk Island, but strangely enough not in Tasmania. It appears to have reached a fixed stage of colour development throughout its range, with the brightest coloration noticeable at the southern and northern limits. The Kangaroo Island form, *Pl. e. melanoptera*, and the northern Queensland form, *Pl. e. nigrescens*, are brighter coloured and the plumage markings are much darker generally. The Kangaroo Island form is said to attain adult plumage after the first moult.

Pl. adelaidae is rather a doubtful species, and still awaits determination. The several sub-species named confuse the issue.

If one follows the distribution of this parrot from South Australia along the course of the River Murray and its tributaries to inland New South Wales, one must surely be impressed by the marked variations noticeable in the plumage colouring, a gradual development from a *Pl. elegans* form in the south to *Pl. flaveolus* of, say, the Murrumbidgee River district. Proof, one may suggest, that it still is in a transitional stage of colour development. Another noticeable feature is the somewhat close resemblance of certain phases of *Pl. flaveolus* to *Pl. caledonicus* of Tasmania, a point worth consideration, in view of the evidence noticeable with fixed species like *Pl. elegans* and *Pl. eximius*.

Pl. adscitus also shows remarkable colour variations; in fact, one rarely sees two birds alike; this is most noticeable in males from far northern Queensland. Birds from northern New South Wales and southern Queensland show less variation and have white cheeks: the validity of this species *palliceps* is in question.

Pl. venustus is an isolated race, with a distinctive and fixed colour development more suitable, as Iredale suggests, to a colder climate like Tasmania than tropical Australia.

Pl. eximius, perhaps the most beautiful of all the rosellas, is extremely plentiful and so, neglected. If it was a rare species, the demand for it as an aviary bird would be quite different. Like *Pl. elegans*, it has also attained a definite colour development throughout its wide distribution, with the brightest colouring noticeable at the extremes of its range. The Tasmanian form, *Pl. ex. diemenensis*, shows a greater extent of red on the breast (surprising when one considers that *Pl. caledonicus*, the plainest of the genus, is the only other representative found in Tasmania). The form at the northern end of its range, *Pl. ex. splendidus*, has a rich yellow coloration of the plumage of the upper parts.

Pl. icterotis, of south-western Australia, is another isolated race with a definite and fixed coloration. It shows but little variation over its somewhat limited range.

Purpureicephalus spurius, of south-western Australia, is quite distinct as regards plumage pattern and coloration; also in the extraordinary development of its bill. Latest reports state that the species is well established,

and in some districts is regarded as a pest. Very little colour variation is noticeable, and only one sub-species, *Pu. s. carteri*, is recognised.

The genus *Barnardius* requires revision, as 4 species are recognised by most Australian workers, and two by Mathews. *B. barnardius* shows considerable colour variation throughout its range; several intermediate forms are noticeable with a pallid one, *B. b. macgillivrayi*, at its northern extreme. The same variations also occur with *B. zonarius*, with a pallid form, *B. b. occidentalis*, in mid-western Australia, and the larger and brighter coloured *B. b. semitorquatus* of south-western Australia. These birds make excellent inmates of an aviary, and should breed readily. The red forehead of *B. barnardius* is missing in *B. b. macgillivrayi* which also has bluish cheeks and wing-coverts. *B. zonarius* has no red forehead, so conspicuous in *B. b. semitorquatus*; the red forehead is also absent in mid-western birds which, however, have blue cheeks.

The genus *Psephotus* has two representatives, *Ps. haematonotus* and *Ps. varius*. The first is very common and shows little, if any, colour variation over its wide distribution. It is a general favourite as an aviary bird, and several xanthic sports are on record.

Ps. varius differs considerably in the plumage pattern and coloration from the preceding species. It has a wide distribution, shows marked colour variation, and is a species that requires further investigation chiefly as regards its generic relation to *Ps. haematonotus*.

The genus *Northiella* has one representative, *N. haematogaster*, with two well-defined forms, *N. h. haematorrhous* and *N. h. narethae*. As there exists considerable uncertainty as regards this species, one is hopeful that special attention will be devoted to it in the near future. Again, one may suggest a closer relationship generically to *Platycercus* than where it is now placed. Fortunately, these parrots are plentiful and live well in captivity.

The next genus, *Psephotellus*, includes three of the outstanding species of Australian parrots.

Pse. pulcherrimus is near extinction, *Pse. chrysoterygius* is rare with a limited habitat, while *Pse. dissimilis* is not common anywhere over its range. With these parrots one notices another distinctive plumage pattern which separates them from, say, *Ps. haematonotus*.

Pse. pulcherrimus, the well-named Paradise parrot, is very rare, only odd pairs having been recorded during the past thirty odd years, the last record being that by C. H. H. Jerrard in southern Queensland. One may suggest that an attempt should be made to secure a pair and try and breed them in captivity. There are numbers of experienced aviculturists in Australia only too willing to undertake the task, and there seems no reason why this species cannot be re-established under such conditions. *Pse. dissimilis* has bred in captivity, and Maclellan hand-reared several young of *Pse. chrysoterygius*, which later on were sent to Taronga Zoological Park, where they lived for several years.

These species nest in termites mounds, and in the nests of *Pse. chrysoterygius* a lepidopterous scavenger, *Neossiosynocca scatophaga* (Turner, 1923) lives, the larvæ of which subsists on the excreta from the birds. It would be of great scientific interest if a similar or another species of this strange moth should be obtained from the nests of the two related parrots.

The genus *Neophema* has two very beautiful representatives, *N. pulchella* and *N. splendida*, both very rare species. The first, the Turquoise Parrot, was thought to be near extinction, but during recent years has reappeared in several districts where the species was hitherto unrecorded. It

is a charming bird, and thrives well and breeds readily in captivity. Many Australian aviculturists have achieved wonderful successes, rearing as many as two, even three, broods in a season.

N. splendida, the prettiest of all small parrots, was considered extinct, and only very recently has been rediscovered. A few pairs were secured, one pair being presented to His Majesty the King, who is Patron of the Avicultural Society, England. The success achieved by Mr. Simon Harvey, of South Australia, in rearing this beautiful parrot in captivity for the first time on record is deserving of our unstinted praise. This latest success proves definitely that it is possible to breed and rear, even very delicate species of parrots in captivity.

The genus *Neopsophotus* is represented by a very charming species, the Bourke Parrot, *Ne. bourki*. It has a distinctive plumage pattern, with a coloration uncommon among parrots. For quite a long time this species was considered to be practically on the verge of extinction, but it is pleasing to note that during the past few years numbers have been recorded in parts of Central Australia. As an aviary bird it is in great demand, as it lives and breeds well in captivity, numbers being reared each year by Australian aviculturists.

The genus *Neonanodes* includes four species, namely, *Neo. chrysogaster*, *Neo. chrysostoma*, *Neo. elegans* and *Neo. petrophila*. These pretty grass parrots have the same plumage pattern and closely resemble each other in coloration. All these species are considered rare, as only small isolated flocks are recorded in districts where once these birds were plentiful. *Neo. chrysogaster* is extremely rare; in fact, it is doubtful if it still exists; perhaps if a large series were examined it may prove to be only a brighter coloured form of *Neo. elegans*.

Neo. chrysostoma is also rare, though it is considered more common in Tasmania than elsewhere. It has been successfully bred and reared in captivity by several aviculturists, and also successfully crossed with *N. pulchella*.

Neo. elegans, although not as rare as the other species, is still in danger of extinction and consequently in need of strict protection. One detects slight colour variations, chiefly noticeable in very old males, many of which have a decided orange patch on the lower abdomen. It also lives and breeds well in captivity.

Neo. petrophila appears to be chiefly confined to the islands off the coast of south-western Australia, as it is seldom recorded from the mainland. It is a sombre-coloured bird when compared with the other species, and shows little colour variation. This is another species that lives and breeds readily in captivity.

The next genus, *Lathamus*, has one representative, the Swift Parrot, *L. discolor*. It has a distinctive plumage pattern with little, if any, colour variation throughout its extensive range. This species is fairly common and has been bred and reared successfully in captivity.

The remaining species on the list are Ground Parrots of the family *Pezoporidae* and represent three distinct genera. These parrots are very alike in their plumage pattern and coloration and, in this respect, show a certain relationship with the New Zealand parrot, *Stringops*. The genus *Melopsittacus* has as its lone representative the charming Budgerigar, *M. undulatus*, the parrot with a world-wide popularity as an aviary bird. It shows little, if any, colour variation throughout its wide distribution, although a paler form is said to occur in north-western Australia. One would

expect a greater colour variation in such a virile species, but, strangely enough, very few aberrations occur. This is still more remarkable when one realises that aviculturists have succeeded in establishing over twenty coloured varieties of this charming little parrot by scientific selection based upon Mendel's theory. The rearing of Budgerigars in captivity is the popular craze of aviculturists in practically every country in the world.

A few years after Gould introduced the species in England in 1840, this parrot was being bred in captivity as readily as the canary. Begun in the most modest fashion by amateurs, the hobby became so popular that many breeding establishments soon assumed the proportions of industrial undertakings. The Belgians were the first to breed these birds on a large scale, to be followed shortly by the Germans and French. Since then, large Budgerigar farms have been established throughout the British Isles, America, Japan, and latterly, in Australia, the home of the species.

To gain some idea of the immensity of some of these European Budgerigar establishments, the following extracts, taken from *L'Oiseau*, of the Bastide Brothers "Parrucheries" in the Avenue Frizac, Toulouse, France, should suffice.

This establishment was founded as long ago as 1880 with stock procured from Belgian breeders. Just prior to the great war, this Budgerigar farm consisted of 290 spacious aviaries, each 4 metres long, 6 deep and 3 metres high, with an average population of between 80,000 and 100,000. It also includes their "Jardin d'Acclimatation," a huge open-air rearing ground, covering two and a half acres and containing 112 aviaries, arranged in most attractive surroundings.

The quantity of food consumed is enormous—every two or three months 600 to 1,000 sacks of millet are required by the Bastides to feed their birds, and this quantity costs annually between 350,000 and 360,000 francs. If one adds to this amount the cost in wages of at least twenty employees, and the interest on the enormous capital locked up in this enterprise, one can readily realise the number of birds that are bred and sold each year to make the undertaking a profitable one. Some of the coloured varieties are really beautiful, more especially the blues, of which there are three distinct shades. It is pleasing to record that one of our members, Mr. H. E. Peir, has succeeded in establishing at least two new coloured varieties besides others already known.

The genus *Pezoporus* is represented by one rare species, the Swamp or Ground Parrot, *Pe. wallicus*. This beautiful species shows very slight, if any, colour variation throughout its range, although three sub-species are recognised. It is difficult to understand why this parrot should appear to be so rare, as it has a wide distribution, inhabiting as it does, the swampy heath-lands bordering the coastline of southern Australia and Tasmania. Maybe that owing to its ground-frequenting habits it is an easy prey for those introduced pests, the fox and domestic cat. There is no record of it ever having been bred in captivity, and one makes the suggestion that if an attempt be made to do so, it should prove successful.

The last genus on the list, *Geopsittacus*, has one very rare representative, the Night Parrot, *G. occidentalis*. This species, never at any time known to be common, has been "lost" for many years. The few specimens examined in Australian collections show no colour variations, and only one sub-species is recognised.

The last "record" consists of some feathers, said to belong to this parrot, which were procured by F. Lawson Whitlock in Central Australia. Whitlock

also had a conversation with the aboriginal, a gin, who had eaten the owner of the feathers for supper the previous evening.

There is one breeding record in captivity. Brisay (*Dans nos volières*, p. 135), states that Dr. Karl Russ bred the species in 1877.

This, however, appears a doubtful record, as specimens of the species are rare in museums and private collections.

The breeding successes achieved abroad by aviculturists with many species of Australian parrots recorded by Hopkinson (*Records of Birds Bred in Captivity*, 1926) prove conclusively how popular these birds are, and how it is possible, even under adverse climatic conditions, to breed them successfully. Unfortunately there are few published breeding successes by Australian aviculturists, although many species have been bred for numbers of years. The following "first records" listed by Hopkinson are interesting, inasmuch as they include several of our rarer species.

Trichoglossus moluccanus—have been often bred, especially in former days. Neunzig says they "were first bred by Heublin in Coburg in 1873, and since by many others,—to the third generation by Petermann at Bostock."

Trichoglossus rubritorquis—first bred at the Zoological Gardens, London, in 1910. An early breeding record in captivity of a Lorikeet, more than likely this species, is to be found in Latham's (*Gen. Hist. of Birds*, Vol. II., p. 123) under "Red-breasted Parrot." He writes: "M. Levallant informs us that a pair of these imported from Amboina, bred in the menagerie of . . . the Governor of the Cape of Good Hope. The female made the nest, lining it with feathers from her breast, and laid two white eggs; the young were hatched in 19 days; they were at first covered with greyish down and by degrees gained the green feathers and the blue on the head, and the parents continued to feed them for six months."

Psittenteles chlorolepidotus—first bred in England by "H.J." in 1883-84. Two young reared. Neunzig says: "In 1890 they were bred at Berlin Zoo in a glass cage with one square metre floor space and one metre high . . . the young left the nest box when two months old and were fed by the old birds for a long time afterwards, but eventually took to foraging for themselves."

Glossopsitta concinna—Neunzig says: "Bred by Nagel in 1903."

Callocephalon fimbriatum—bred by Madame Lecallier in France in 1921.

Kakatoë galerita—bred by Dulitz in France in 1883; also in Berlin by Neunzig in 1883, 1890, 1891, ad 1892.

Lophochroa leadbeateri—first bred by Mrs. Johnstone in England in 1901; also bred and reared at the Zoological Gardens, London, in 1906, 1907 and 1922.

Ducorpsius sanguinea—bred at the Zoological Gardens, London, in 1907.

Eolophus roseicapillus—three young were reared by Cosgrave in England in 1922; the parent birds were kept at liberty. Delacour states that they were bred in France in the same year by Baronne Gourgau.

Leptolophus hollandicus—said to be commonly bred, but no first record listed.

Polytelis swainsoni—bred by Maillard in France in 1889, and by Farrar in Yorkshire in 1900, who reared three young ones. In 1918 two young ones were reared by the Marquis of Tavistock.

Polytelis anthopeplus—bred by Johnstone in England in 1903.

Spathopterus alexandrae—bred by Astley in England in 1912, who also had continued successes in the following years.

Aprosmictus erythorpterus—bred in France by the Marquis de Brisay in 1880 and by Delaurier later. Russ states that Seybold bred the species still earlier. Was first bred in Great Britain by Morshead in 1901.

Alisterus scapularis—Neunzig says the first breeder was Kohler of Weissenfels in 1880, and in the same year they were also bred in France by Rousse. Two British records are Salter in 1905, one young reared, and Amsler in 1921, also one reared.

Platycercus elegans—the earliest record is that by Rousse in France in 1880. The species is said to have been quite frequently bred abroad.

Platycercus adelaidae—first bred by Fasey in England in 1907, four young reared, and in 1914 one was reared by Poltimore.

Platycercus caledonicus—Russ says the first breeder was Cornely in 1882.

Platycercus flaveolus—first bred in Great Britain by Fasey in 1904, four young ones reared. Neunzig states: "Has been bred in England, and in 1892 . . . at Copenhagen."

Platycercus adscitus palliceps—repeatedly bred, says Neunzig. Early French successes include Delamain and two others mentioned by Brisay (1882). British records are Sergeant, before 1895, Arthur, 1899, and Raynor, 1914, one reared.

Platycercus eximius—the earliest record is Jourdain in France in 1877. "Have been repeatedly bred and readily go to nest," states Neunzig.

Platycercus icterotis—bred by both Astley and Fasey in July, 1908; in the same year Perkins also bred them. Smith of Kendal had success for several years, 1910 to 1915.

Purpureicephalus spurius—bred by Astley and Fasey in 1909; two almost simultaneous "first successes" won by the former who was awarded the Avicultural Society's Medal.

Barnardius barnardi—"Have been repeatedly bred both in England and France," states Neunzig. Cornely bred them in 1882, and the first British record is Mrs. Johnstone in 1902. The Marquis of Tavistock also bred the species in 1913 and later.

Barnardius barnardi semitorquatus—the first success, according to Neunzig, was at the Zoological Gardens, London, in 1862; they were also bred in 1912.

Barnardius zonarius—were bred and the young reared by Kohler in Germany in 1879.

Psephotus haematonotus—early records include Cornely in Holland in 1865 and Rothschild in France in 1868. Among the British records are Farrar in 1903 and Read in 1912. They are usually quite easy to breed, and, according to Neunzig, "are frequently bred by the trade."

Psephotus varius—bred in France by Jourdain in 1877, and in England by Farrar in 1902 and Fasey in 1903.

Northiella haematogaster—Cornely is said to have been the first breeder of the red-vented form in 1882. The first British record is that of Duncan Parker in 1909. The species has also been bred by the Marquis of Tavistock in 1920.

Psephotellus pulcherrimus—Neunzig says that they have been bred a few times abroad; the first, according to Russ, being Princess Saxe-Coburg-Gotha in Vienna. Gedney also claims success in England.

Psephotellus chrysapterygus—a hybrid record only, a very doubtful one.

Psephotellus dissimilis—first bred by Astley in 1912. Four young birds were hatched in November and all reared.

Neophema pulchella—Neunzig says were first bred at the Antwerp Zoological Gardens in 1861, and then by Leuchfeld at Nordhausen. In the Zoological Gardens, London, numbers were reared between the years 1860 and 1863.

Neopsephotus bourki—first bred by Russ in 1880 and in Great Britain by Fasey in 1906, five young ones being reared. In 1911, Astley reported that they had been breeding with him for the last four years.

Neonanodes chrysostoma—this species is said to have been first bred by Cornely in 1885-1886. Fasey bred them in 1909, and they were also bred by the Marquis of Tavistock in 1917.

Neonanodes elegans—Neunzig states: "They have been bred in Holland, Belgium and England."

Neonanodes petrophila—Russ bred them before 1880, the first and, so far, the only success recorded abroad.

Lathamus discolor—Neunzig states: "With Alfred Rousse in Belgium in 1887 a cock nested successfully with two hens; one hen had five, the other four young, which all lived to adulthood."

Melopsittacus undulatus—according to Russ the first breeder was Graf von Schwerin in Germany in 1855.

There are a number of causes responsible for the gradual diminishing in numbers of many species of parrots, yet it is difficult to understand why some should be rare, while others living in the same areas are still plentiful. The food problem cannot be responsible, as a shortage would affect all species. Perhaps it is an instance of the survival of the fittest; for example, several rare Grass Parrots appear unable to withstand the changed conditions brought about by settlement, while more robust species like the Rosellas thrive readily.

Numbers of parrots, as well as other species of birds, are being destroyed each year, victims of poisoned baits and water used in the destruction of rabbits. Likewise, bush and grass-fires, severe hail-storms, drought and heat-waves kill many thousands.

The introduced Starling is also responsible for the scarcity of many species in settled areas, as it is noticeable that these verminous birds have so infested nesting trees that parrots and other birds have been forced to abandon their usual nesting sites and seek new ones.

A severe heat-wave, however, is as great a menace as any that our wild life has to contend against. During the terrific heat-wave of January, 1932, which affected the whole of the interior of the continent, millions of birds of all species succumbed to the heat. The following account appeared in *The Advertiser* of South Australia under date 12/5/1932:—

"At Kokatha Station, situated between Lakes Harris, Everard and Gairdner, and about 30 miles south-west of Kingoonya Station, on the Trans-Australian railway line, Mr. Reg. Wilson stated that 'the Shell Parrots (Budgerigars) *Melopsittacus undulatus* must have died in millions.' From one of his dams he said he took out and burnt about five tons of parrots. 'We made a net with wire-netting,' he said, 'and dragged it from one side to the other and then extracted the birds, as the fisherman does his fish. We filled a petrol tin and weighed it, and then by counting the tins were able to arrive at the weight. From one of the tanks we took out 30,000

dead parrots. The birds would settle on the water for a drink; others would follow and push them under the water; and this went on until dead bodies were many inches thick.'"

In conclusion, I wish it to be clearly understood that in advocating the breeding of parrots in captivity, especially the rarer species, I do so in the hope that such breeding will be carried out under license and in a purely scientific manner, but not on a commercial basis.

A NEW SPECIES OF FINLAYA (ORDER DIPTERA: FAMILY CULICIDAE)
FROM PAPUA.

By FRANK H. TAYLOR,

School of Public Health and Tropical Medicine, Sydney.

AEDES (FINLAYA) LITTLECHILDII n.sp.

♀.—Head, clothed with dusky brown flat scales, with a median line of white scales, flat and linear, mostly the latter, and a few black upright-forked ones at the base; a fringe of small narrow white scales bordering the eyes and extending to the sides and base of the head; where the scales are broad, the whole pattern assumes the shape of a sickle without a handle; antennae black, second segment reddish-brown, the latter with small white scales, also the inner surface of the first segment similarly clothed; palpi covered with black, apices with white scales; clypeus black; proboscis black, not banded.

Thorax, covered with narrow-curved dark coppery-brown scales; a narrow median white-scaled line extends from the anterior margin to the scutellum, where it bifurcates just in front of the scutellum, and a narrow outer, lateral, lyre-shaped line of small spindle-like scales ending posteriorly at the scutellum; pleurae with patches of white scales not arranged in definite lines; scutellum: mid lobe with flat white and brown scales, lateral lobes with white narrow scales; wings with the base of the first fork-cell some distance nearer the base of the wing than that of the second; vein scales dusky-brown.

Legs, blue-black; femora white scaled beneath; tibiae with white basal banding; first and second tarsal segments of fore and mid legs with white basal spots, remaining tarsal segments without spots or banding; tarsal segments one, two and three, of hind legs with broad white basal banding, fourth unbanded, fifth entirely white.

Abdomen black; first segment with dusky-brown scales, second, third and fourth segments, with white sub-basal banding becoming basal in the middle, fifth segment with an incomplete sub-basal band, prominent laterally, second segment with a prominent white lateral basal spot; remaining segments unbanded; venter black; segments two to five inclusive, with white basal banding.

Length: 5 mm.; wing, 3.25 mm.

Habitat: Kokoda-Buna district, North Eastern Division, Papua.

Distinguished from *F. notoscriptus* Skuse, and *F. albilabris* Edwards, *inter alia*, by the banded proboscis and from *F. pulcherrimus* Taylor, by the abdominal and leg ornamentation.

It affords me much pleasure to dedicate this species to its discoverer. Type in the collection of the School of Public Health and Tropical Medicine.

THREE NEW SPECIES OF DRYOPIDAE.

By H. J. CARTER, B.A., F.E.S., and E. H. ZECK.

SIMSONIA COTTERENSIS n.sp.

(Plate xix., Fig. 1.)

Elongate-obovate, nitid metallic black or very dark purple above and beneath, legs dark, antennae flavous, its apex infusate, whole surface glabrous.

Head strongly, not densely, punctate, eyes large and prominent.

Prothorax, apex roundly produced in middle, anterior angles defined, slightly obtuse, base subtruncate; widest behind middle, sides sinuately narrowed to the front, scarcely sinuate behind, posterior angles obtuse. Disc strongly bilobed, separating sulcus nearly straight, with a shallow medial extension behind, lateral foliation rather wider than usual, extreme border narrow and entire, a short subobsolete, sublateral carina at base, fine, somewhat irregular punctures on surface, these coarser towards sides.

Elytra: Widest behind middle, subsinuate before apex, margins entire, striate-punctate, the striae most clearly defined at sides, elsewhere confused by small, oleaginous, irregular rugae that follow the lines of the striae; striae punctures finer than in *S. wilsoni*, intervals with a single line of minute punctures. Underside with moderately large, scattered punctures over the sternal regions—except on prosternal process—the latter rather widely rounded, carinate along middle.

Dimensions: 2.6 x 1 mm.

Habitat: Federal City Territory, Cotter River. (Miss W. Kent-Hughes).

Sixteen examples sent by their captress, one of the entomological staff of the Research Council at Canberra, were at first diagnosed as *S. wilsoni*. Further examination showed well defined distinctions. (a) Much finer elytral sculpture, with its minute, longitudinal rugae—these sometimes linear—elsewhere like minute drops of oil; (b) dark legs and underside; (c) prothorax more widely foliate with deeper transverse sulcus.

Holotype in Coll. Carter.

SIMSONIA LONGIPES n.sp.

(Plate xix., Fig. 3.)

Elongate-obovate, black nitid and glabrous above. Antennae red with apical segments dark, tarsi piceous.

Head closely punctate, eyes not prominent, antennae lineate, extending to middle of prothorax.

Prothorax, anterior lobe convex and produced at middle, anterior angles rounded, base subtruncate, posterior angles obtuse; widest behind middle, sides here moderately rounded, lobes separated by a wide, deep and almost straight depression producing a slight sinuation at sides; disc with rather small punctures not closely set.

Elytra distinctly wider than prothorax at base, widest behind middle; striate-punctate, the striae shallow, the punctures therein not large, evenly and closely set, intervals flat, closely and finely punctate, with here and there fine transverse rugae.

Prosternal process narrow and rounded at apex, bisulcate, with a raised medial division; metasternum with coarse, shallow punctures.

Abdomen sublaevigate, with a few scratch-like punctures, the apical

segment finely granulose. Legs unusually long, inside of tibiae with a thin line of hair, post tibiae feebly curved.

Dimensions: 2.3 x 0.9 mm.

Habitat: S. Queensland, Pine River, Petrie district. (Leathom Wassel).

Eleven examples, taken by this keen young entomologist, can only be confused with *S. angusta* in our table of the genus. It is, however, larger, with finer punctures on the pronotum and in the elytral series, besides having evidently longer legs. Holotype in Coll. Carter.

AUSTROLIMNIUS OBLONGUS n.sp.

(Plate xix., Fig. 5.)

Oblong-oval; upper surface and sternal regions nitid brownish black, abdomen brown, legs and antennae pale, the knees dark.

Head and prothorax sublaevigate, or only microscopically punctate, the latter produced partly over the head; widest at middle, sides lightly rounded, hind angles obtuse, medial and sublateral sulci clearly cut but not wide, lateral margins minutely serrulate.

Elytra oblong, margins minutely serrulate, the lateral carinae distinct, the interior one widest; seriate (scarcely striate), punctate, the seriate punctures regular, small in the 4 dorsal rows, larger in the 2 rows between the interior and 2nd carinae; a single row of still larger punctures between the 2nd and lateral carinae; intervals flat and laevigate.

Prosternum very convex, its process rather wide, but narrowing to a subtruncate apex, its surface smooth, its border raised. Metasternum and abdomen very minutely punctate. Male with fore tarsi dilated and flattened, mid-tibiae with pointed process on inner side at apex, and 4 comb-like structures midway between apex and base. Hind tibiae subangulately widened, also bearing 3 or 4 short comb-like structures. Female with all legs normal.

Dimensions: ♀—1.6 x 0.6 mm.; ♂—slightly narrower.

Habitat: N.S.W. Lannigan's Creek, Burragorang. (Consett Davis).

Four examples were found by this energetic naturalist in February. It is more elongate and flatter than usual, but has the special characters and prosternal process of the genus. Holotype (♂) and Allotype (♀) in Coll. Carter.

Explanation of Plate xix.

Fig.

1. *Simsonia cotterensis*.
2. Sternal process of *S. cotterensis*. x 42.
3. *Simsonia longipes*.
4. Sternal process of *S. longipes*. x 42.
5. *Austrolimnius oblongus*.
6. Sternal process of *A. oblongus*. x 42.
7. Fore tarsus of male *A. oblongus*.
8. Middle tibia of male *A. oblongus*.
9. Hind tibia of male *A. oblongus*.

HABITS OF THE SYDNEY OCTOPUS (*OCTOPUS CYANEUS*) IN CAPTIVITY.

By A. S. LE SOUEF and JOYCE K. ALLAN.

(Plate xx.)

It is well known that Cephalopods, particularly the Octopods, have a more highly developed organisation and advanced intelligence than other invertebrates, and for this reason make fascinating subjects for aquaria.

Madame Powers, to whom went the honour, early in the nineteenth century of clearing the mystery of the Argonauta shell, studied many molluscs in her marine aquarium, and was most emphatic about the cunning intelligence of the octopus, especially when capturing prey. One day she observed an octopus in captivity closely watching a *Pinna* slowly opening the valves of its shell. When the valves were completely opened, the octopus with great rapidity placed a stone it held in its arm between them, preventing the valves from closing and thus enabling it to grab out the animal and devour it. Though she mentions this as only one of the many strategies resorted to by the octopus in confinement, yet to us it seems rather far-fetched and incredible that the animal should wait armed with a stone for such an opportunity. At the same time, recent research has proved that a great many of the statements made by Aristotle about habits of marine animals, including the octopods, and hitherto disbelieved are comparatively accurate, so that even this story of Madame Powers' may have some basis of fact.

Nevertheless, whether crawling over the rocks, swimming about, or crouching, partly hidden in a corner of the aquarium, the extraordinary shape and bright never-moving eyes of the octopus always arouse the utmost interest, and even a limited study of them results in the disclosure of some astonishing facts about their habits.

During the last two years we have had the opportunity of studying several large octopods in captivity in the aquaria at Taronga Park Zoological Gardens. These were all the same species (*Octopus cyaneus*), the largest species found in Sydney Harbour, where it occurs all the year round and is most abundant in the summer months. The animal is very strong, with a wide web and long arms, which when stretched out reach over two feet. The body, in an average specimen about eight inches long, is covered on the upper surface with rough granulations, but the underneath surface is smooth. The cups on the arms are very wide, some being an inch in diameter.

The octopods are usually littoral and nocturnal in habits and during the day mostly hide away in rock shelters, so that in captivity it is only natural that they should spend a greater part of the day crouched in between rocks or in corners of the aquarium, where they are often hard to distinguish from their background. The power of camouflage is most noticeable, and the colours vary from the palest shades to the very deepest reds, constantly and often without apparent reason. When resting the usual colour of the octopus is greyish-pink, but will change to a deep terracotta red blush if disturbed, and the raising of the tubercles on the head and body give an angry appearance to the animal.

Though space is necessarily limited in the aquarium, and the octopus has not the unrestricted area in which to sport itself that it has in a natural habitat, yet swimming movements can often be seen. The backward one, by far the swifter, is performed by expulsion of water from the siphon, the

arms and body meanwhile stretched out motionless in a horizontal plane. The forward movement is made by the opening and coming together of the large web at the base of the arms, and is very clumsy. The octopus depends very much on its eyesight, and it is noticed that however much it is hidden away or has its long arms wrapped round it, a common attitude, yet one bright eye is always exposed and on the lookout.

When food, generally shrimp in captivity but in natural life, shells, crustaceans and small fish, is dropped in, two long dorsal arms are stretched out to a surprising length to capture it. These two arms incidentally seem to be always used for this purpose, the others more for clinging to rocks or walking. The food is conveyed to the mouth by the arms, and the wide web closes over hiding the actual feeding action, but not before a temporary glance is seen of fleshy lips receding, baring a strong dark parrot-like beak, clutching at the food.

While the octopods were in captivity, dozens of little transparent umbrella-shaped structures were noticed floating about in the water. These are the inside lining or epidermis of the cuplike suckers on the arms, which are rejected at intervals in entirety; the epidermis, however, is renewed by a new growth.

The octopods are not always peaceful inhabitants of an aquarium, as many fights occur amongst them, resulting in the mutilation of limbs and ending with the death of one or sometimes more victims. It has been found that a broken portion of an arm can be replaced with a new growth, and a small octopus found on the Great Barrier Reef repeatedly throws off its arms when handled or disturbed and later grows new ones.

In September, 1932, a female octopus laid a batch of eggs in the aquarium. Until this happened it was not known which were male or female octopods there, as, although the sexes are distinct, the difference between them is not so apparent as in the cuttles. In these, the female is generally believed to be distinguished by its larger size and different colour.

Reproduction in the octopods, as in most of the Cephalopods, takes place by means of an arm especially modified in the male octopus for this purpose; it differs from the others in shape and sometimes becomes detached from the male and remains in the mantle of the female where it leads an independent life. This is known as the hectocotyliised arm, and differs in its position in the circlet of arms and its structure, in different genera. In the octopus it is longer than the other arms, and terminates in an oval expansion marked with transverse ridges and intervening depressions. The spermatozoa are believed to be conveyed to this expansion through a passage connecting it with the base of the arm. In some members of the group, spermatozoa are expelled through the siphon of the male from the branchial cavity and enter that of the female along the current in inspiration.

As the female was not recognised in this instance until the eggs were actually being laid, it is not known, unfortunately, how reproduction took place with the species in the aquarium. The eggs were laid in great numbers, attached firmly to the wall of the aquarium behind some rocks, and were well guarded by the female, who constantly sat over them aerating them with water from her siphon and preventing any interference.

A favourite and general position was to sit with her back to the eggs and her arms turned over them, at the same time flushing the eggs first on one side and then the other with water from the siphon, as the illustration shows. The respirations at this time, about forty a minute, seemed more rapid than normal.

Though it has been thought by some that the female octopus hatches her eggs, the actual sitting over them is in reality a mere protection, and, under favourable conditions, the young would hatch out unattended.

The eggs were rarely left, and only after a month of careful watching did the female octopus move a little distance away from them, but returned immediately if any attempts were made to detach some.

The general egg-mass was dark-brownish coloured, and consisted of about fifty to one hundred long narrow strips placed separately on the wall. When a few of these strips were examined they were found to be composed of about thirty to fifty capsules, enclosed in a clear mucus, very similar to that enclosing whelk eggs, and which hardened when it came in contact with the air. Each pale balloon-shaped capsule contained a single embryo and was attached by a long thin stalk to the main stem, and when imbedded in the mucus was opaque and milky white. As the embryo developed the capsule became transparent, the milky white disappeared and the embryo was clearly distinguished in formation. At this stage of development the capsule broke from the mucus and remained suspended by its long stem to the end of the whole strip. By the end of October, about one month after being laid, the capsules were 3 mm. long, the embryo inside being 1 mm. long, and under the microscope they were pale yellow and showed early indications of a young octopus. They were rounded at one end and tapering towards the other. By the 9th November the embryos were slightly larger, but were no further developed. Some of the capsules were still opaque and imbedded in the mucus; others were transparent but empty.

Unfortunately, the female died a few days after the last examination. Throughout the period of guarding her eggs she had practically refused all food, a fact which has been noticed about these animals in aquaria in other countries. When the female was examined, the interior was found to contain hundreds of unladen eggs which may have accounted for a sickly appearance previous to her death. Soon after the female died, the remaining octopods in the aquarium appeared sick and gradually died.

The eggs were left on the wall, as it was hoped that the female's death would not interfere with their development at this late stage, but though batches were taken at intervals for some while afterwards, no improvement was noticed and the mass gradually broke up without the embryos developing beyond the stage they had reached prior to the female dying.

Aristotle asserted, and others have since proved, that from the time the egg is deposited until it hatches out, the formation of the young octopus takes about fifty days, so that when unfavourable conditions intervened, the embryo octopods in the aquarium were well on their way towards complete development.

The breeding season of octopods, as with other molluscs in New South Wales, seems to take place at intervals throughout the year, although it may be more pronounced at one season than another and is somewhat influenced by climatic conditions.

The eggs mentioned were deposited by a fully grown female in the spring, but in the autumn, on the 13th April, 1933, another octopus of the same species, but of much smaller size, laid eggs behind rocks in the aquarium. They were all opaque and none had begun development beyond this stage. The process of laying seemed a painful one, and on the 24th April the octopus died after laying only very few eggs. When the octopus was examined, the ovary was found to be distended with ova in various stages of development, but none as advanced as those deposited.

If the statement made by several authorities is correct, that after she has laid her eggs, an exhausting operation, the female octopus, as well as the male soon dies, then the death of the octopods in the aquarium at Taronga Park is only a natural event, which would take place, even if the animals were not in captivity.

EXPLANATION OF PLATE XX.

Fig. 1. Sydney Octopus (*O. cyaneus*) sitting on eggs in the Aquarium at Taronga Park, Sydney.

„ 2. A single strip of the egg capsules.

„ 3. A single egg-capsule, showing the embryo within.

NEARLY A TRAGEDY IN WILD LIFE.

By HENRI MALLARD.

On Sunday morning, the 7th of May, I was awakened by an unusual screeching of angry birds. It was just daylight and, as the row persisted, I rose and, on scanning the tree tops below my verandah, I observed two black and white Butcher Birds waging war on something amongst the top branches. On closer scrutiny, what I took to be a rat was their objective, and it seemed to be having a bad time, realising that from where I stood the rat, if it was one, must have been a very large one. On putting field glasses on the spot, I discovered that it was a full-grown ring-tail opossum. It was running, jumping and dodging its merciless attackers, giving one blow for every half a dozen it received. Gradually it became almost frantic and made an attempt to run down the trunk of the tree. Immediately the attack became more systematic, each bird taking a position, one above and the other below, and as the opossum attempted to either run up or down it was dually attacked. Finally, it got down to within my reach, the birds still attacking, regardless of my presence; in fact, I believe that I could have caught the lower Butcher Bird with my hands; they, as well as the opossum, were tiring visibly. When I lifted the opossum from the tree he was bleeding from wounds in the side, head and tail, one eye was pierced and the skin above the other was broken, just missing the other eye by less than half an inch. I am still doctoring a very sick opossum and, although his case seemed hopeless at the start, I believe that, apart from the loss of one eye, he will eventually be able to enjoy life amongst the tree tops of Avenue Road, Mosman.

NEW GENERA AND SPECIES OF MARINE DECAPODA BRACHYURA.

From the Coasts of New South Wales and Queensland.

By MELBOURNE WARD, F.Z.S., Honorary Zoologist, Australian Museum.

Subtribe OXYSTOMATA. Family RANINIDAE.

Genus LYREIDUS de Haan.

Lyreidus de Haan, Crustacea in Seibolds Fauna Japonica, 1841, 140. Haplo-type *L. tridentatus* de Haan. Type loc., Japan.

LYREIDUS AUSTRALIENSIS sp. nov.

Pl. xxiii., fig. 10.

L. tridentatus Haswell (nec. de Haan), Cat. Aust. Crust., 1882, 144. Port Stephens, N.S.W., and outside the heads of Port Jackson, N.S.W. *Idem*. Whitelegge, Mem. Aust. Mus., iv., 2, 1900, 165.

The Australian species, which has been confused with the Japanese species ever since it was first discovered, is readily separated from *tridentatus* in the following series of characters:—

1. The orbits extend further back on the dorsum of the carapace.
2. The carapace is broader in *australiensis*.
3. The sternum is broader in *australiensis*.
4. Fifth segment of the male abdomen is longer and narrower in *australiensis*—almost twice as long as the preceding segment.
5. The chelae of *australiensis* are longer and more slender, the immovable finger more constricted at the base, the mobile finger is more robust.
6. The dactyli of all the ambulatory legs are more slender.

Lyreidus australiensis is usually obtained by the trawlers on the continental shelf in depths up to 100 fathoms.

Material.—In order to avoid confusion I designate as holotype a male, figured on plate xxiii. Carapace: Length, 44 mm.

Locality.—Within a radius of 10-15 miles of Newcastle, N.S.W., 45-50 fathoms. November, 1931. Coll. by Captain Moller on Trawler Goolgwai.

Family LEUCOSIIDAE. Subfamily LEUCOSIINAE.

Genus CRYPTOCNEMUS.

Cryptocnemus Stimpson, Proc. Acad. Nat. Sci. Philad., x., 1858, 162 (60).

Type *C. pentagonus* Stimpson, loc. cit. and Smth. Misc. Coll., 1907, 163, pl. xiv., fig. 56. Type locality, Japan.

CRYPTOCNEMUS PLANUS sp. nov.

Pl. xxii., fig. 7.

* Type male, 6 mm., total carapace width. Type locality: Lady Musgrave Island, Bunker Group, Queensland. Dredged in the deeper parts of the lagoon.

Description.—The carapace is wider than long, hexagonal; all the margins are strongly upturned and finely granular.

* The types of the species described in this paper are housed in the Australian Museum, Sydney.

A faint ridge extends for a short distance back from the middle of the front on the dorsal surface of the carapace.

The frontal distance between the points of the hepatic protuberances are equal to the posterior margin. In this respect, the species differs from *C. crenatus* Grant and McCulloch, and *C. pentagonus* Stimpson.

The postero-lateral margins are equal to the antero-lateral, in which respect the species again differs from the two closely allied forms.

There is a curving line of granules on the dorsal surface of the manus which commences near the proximal lower angle and ends near the articulation of the dactylus; with the outer margin it forms an oval concave area. The lower margin of the immovable finger is outlined with acute tubercles.

Subfamily PHILYRINAE.

Genus LISSOMORPHA *gen. nov.*

The carapace markedly broader than long; is strongly convex longitudinally and laterally; a broad smooth ridge extends from the base of the frontal region to near the posterior margin. The sides of the carapace form an eave which does not conceal the ambulatory legs. The buccal cavity is nearly square, as that part of the exognath adjacent to the merus of the endognath, is broad, swollen, and globular. The merus extends almost to the broad septum which separates the antennular lossae. The antennules are transverse and are well developed. The orbits are entire and the eyes fit closely, so that little movement is possible. The pterygostomian regions are vastly excavated.

LISSOMORPHA HASWELLI *sp. nov.*

Pl. xxi., figs. 5-6a.

Holotype female 9 mm. wide. Type locality: Off Gatcombe Head, southern end of Facing Island, Port Curtis, Queensland. June, 1929.

The unique female specimen on which the description is based was collected in shallow water with the aid of the naturalist's dredge upon a ground composed largely of broken shells and gravel.

Description.—The antero-lateral margin of the carapace is entire, sinuous, and as long as the postero-lateral; the lateral angles of the carapace have a patch of stiff hairs which spread along the branchial regions and over the general surface of the carapace.

The posterior margin is thick, raised, and smooth; a strongly developed granular ridge extends along the sides of the carapace and is filled with soft, short, thick hairs which extend on to the proximal third of the chelipeds.

The meri of the chelipeds are short and thick, irregularly nodular, but not granular; a large crater-like pit at the external distal extremity; the lower margin has large irregular nodules, and the lower surface has some large, flat smooth granules behind the large marginal nodules.

The carpus is small and globular and has a smooth outer carina.

The manus is short, swollen and strongly punctate. The upper and lower margins are carinate and entire. The dactyli are slightly arched, with a small entire carina along the upper surface.

The meri of the first three pairs of ambulatory legs have the upper margin thin and lined with granules, and there is a second line slightly lower on the outer surface. The carpus has a curved, thin, carina; the propodus has a well-developed carina, leaf-like in formation. The dactyli are slender and acute, and longer than the preceding article.

The abdomen of the female has three segments; the second to the sixth are fused. Broad, deep grooves outline the fused segments, but are interrupted in the middle.

The general appearance of this species suggests *Leucosides* Rathbun, but the form of the buccal orifice and the endognaths of the external maxillipeds and the vast excavations of the pterygostomial regions separate it from that genus.

Subtribe BRACHYGNATHA. Superfamily BRACHYRHYNCHA. Family EURYALIDAE.

Genus JONAS.

Jonas Jacquinot and Lucas, in Dumont D'Urville's Voy. Pole Sud, "Astrolabe" and "Zelee," III., Crust., 1853, 85.

Haplotype *Jonas macrophthalmus* Jacquinot and Lucas, tom. cit., 88. Type locality: New Guinea. From the bellies of fish.

Jonas is readily distinguished from *Gomeza* Gray, by the greater development of the orbits, the more sunken epistome and antennular regions, and by the more elongate carapace and smaller lateral spines. The *Corystes* (*Oeidea*) *distincta* de Haan, should be placed in *Jonas* Jacquinot and Lucas. The varieties of *distincta* described by Balss⁽¹⁾ and McGilchrist⁽²⁾ are in all probability distinct species. *Oeidea* de Haan is considered to be a synonym of *Gomeza* Gray (fide Alcock).

1. *Gomeza distincta* de Haan, var. *formosae* Balss, Zool. Anz. Bd., liv., 1922, 4.
2. *Gomeza distincta* de Haan, var. McGilchrist, Ann. Mag. Nat. Hist (7), xv., 1905, 263. Persian Gulf.

JONAS LEUTANUS sp. nov.

Pl. xxiii., fig. 8.

Holotype male measuring 30 mm. from the tip of the rostrum to the posterior margin of the carapace.

Type locality.—Lindeman Island, Cumberland Group. Dredged on a mud bank in 5-8 fathoms. December, 1928.

Description.—The carapace is elongate, regularly convex, both longitudinally and transversely, and its surface is covered with fine spinules, each with a forward inclination; these are not hidden by the coat of fine adpressed hairs. A median row of five low elevations extends from the posterior part of the gastric area towards the posterior margin. The bases of these elevations are outlined by a sinuous sulcus which commences in the closed fissure of each orbital margin, and continues unbroken, meeting between the third and fourth elevations. The lateral margins of the carapace are lined with ten forwardly directed spines, including the external orbital angles. The spines diminish in size towards the posterior margin. The front is composed of a broad, bifid median spine, having broad U-shaped hiatuses on each side, between it and the supra-ocular margin, except the last, which marks the junction with the posterior spines; the basal articles of the antennae fill these hiatuses. The orbits are large and with a dorsal inclination; there are three large spines surrounding the eye—one very large, one on the inferior margin, one at the external angle, and one above at the internal angle; there is a broad hiatus between the superior and the lower inner orbital angles. Antennules are well developed and hidden beneath the front. The antennae is almost as long as the carapace, fringed with long hairs.

The epistome is narrow and short, not strongly developed. The external maxillipeds close the buccal orifice completely; there is a well-developed

forwardly directed spine at the anterior angles of the buccal orifice. The subhepatic and pterygostomian regions are clothed with long hairs.

The chelipeds are well-developed, not quite as long as the carapace; the merus has long hairs and three spines on the dorsal margin; the carpus is triangulate; the apex below at the juncture with the merus; the dorsal surface is covered with salient spinules and a large upwardly curved spine on the inner margin. The lower margin of the manus is three times the length of the upper margin; the outer surface is covered with rows of spinose tubercles and long hairs; the inner surface is granulated and covered with long hairs.

The ambulatory legs are flattened and the articles are unarmed; their margins fringed with long hairs.

The male abdomen is divided into four segments—the second of which has two large bosses; the fourth segment is very small.

The holotype has been compared with a specimen of *Jonas distincta* (de Haan) from Japan in the collection of the National Museum, Washington. The following characters were noted:—*Jonas distincta* is a shorter and broader species, with a different type of granulation on the carapace; the elevations are more strongly developed.

Jonas distincta (de Haan).

Male: 26 mm. long. Japan.

Lower internal orbital spines advanced as far as the dorsal.

The ten lateral spines are produced laterally, 1 to 3 well developed, more so than the external orbital spine.

Three distinct longitudinal ridges on the dorsum of the carapace; larger granules.

Penultimate segment of the male abdomen very short.

Jonas leuteanus.

30 mm. long. Queensland.

Lower orbital spines produced beyond the dorsal. Lower floor of the orbit is more advanced than in *J. distincta*.

1 to 3 are smaller than the external orbital spine and not as laterally produced as in *J. distincta*.

Three ridges are not so strongly developed; granulation covers more of the carapace than in *J. distincta*.

Penultimate segment longer; half as long as the first.

Family PORTUNIDAE. Subfamily PORTUNINAE.

Genus GONIONEPTUNUS.

Gonioneptunus Ortmann, Zool. Jahrb., vii., Abth. f. Syst., 1894, 79. Haplo-type *G. subornatus* Ortmann. Type locality, Japan. = *Portunus* (*Thalamita*) *truncatus* de Haan.

GONIONEPTUNUS WHITELEGGEI sp. nov.

Pl. xxiii., figs. 1 and 2.

Gonioneptunus subornatus Whitelegge (nec. Ortmann), Mem. Austral. Mus., iv., 2, 1900. Trawled between Botany and Wata Mooli, N.S.W. 50-71 fathoms. H.M.C.S. Thetis.

The following notes of comparison between the specimens before me and the figure in de Haan's Crustacea, Siebold Fauna Japonica, are sufficient to separate the two species, and I take the opportunity to note that the figures published in the Fauna Japonica are reliable reproductions of the species represented. I have had good fortune in being able to examine collections of Japanese species housed in museums abroad, and by critical comparative study of specimens and figures, found them correct to the minutest detail.

1. The proportions of the carapace are different—*G. whiteleggei* is three-quarters as long as broad; *G. subornatus* is two-thirds as long as broad.
2. The male abdomen is narrower in *whiteleggei*; the penultimate segment is long and narrow.
3. The front is one-third the breadth of the carapace in de Haan's figure. The front is less than one-third of the carapace in *whiteleggei*.
4. The transverse ridge from the last antero-lateral tooth is more arched in *whiteleggei* than in *subornatus*.
5. de Haan's figure does not display the strong sculpturing on the carapace which is characteristic of *whiteleggei*.
6. The process on the basal antennal article which fills the orbital hiatus is broader in *whiteleggei* than in Ortmann's figure, *tom. cit.*, pl. iii., fig. 9.

Material.—In order to avoid confusion, I designate as holotype the male, 44 mm., carapace width, figured on pl. xxiii., figs. 1-2.

Locality.—Within a radius of 10-15 miles, off Newcastle, N.S.W., 45-50 fathoms. November, 1931. Coll. Captain K. Moller on the trawler Gool-gwai.

Subfamily LIOCARCININAE.

Genus AENEACANCER *nov.*

The nearest ally of *Aeneacancer* is *Ovalipes* Rathbun, from which it is readily distinguished by the presence of two transparent areas in the dorsal surface of the carapace, near the posterior margin, and which I have called the tympana in the description of the species. Other important characters separate the two genera, and the following list of comparative notes have been compiled from an examination of a specimen of *Ovalipes ocellatus* (Herbst), the typical species collected on the coast of New Jersey, U.S.A.

1. The presence of a stridulating mechanism in *Aeneacancer*.
2. The external maxillipeds are more robust; merus only slightly produced at the antero-external angle in *Aeneacancer*.
3. The orbits are larger in *Aeneacancer*.
4. The regions of the carapace are more deeply marked in *Aeneacancer*.
5. The fronto-orbital region is equal to half the width of the carapace and is produced beyond the outline of the antero-lateral margin in *Aeneacancer*.

AENEACANCER MOLLERI *sp. nov.*

Pl. xxiii., fig. 11.

Holotype male measuring 54 mm. in total carapace width. This is a damaged specimen, having a cheliped and several walking legs missing.

Type locality.—South of Montague Island, N.S.W. Taken in the trawl operating in approximately 40 fathoms on sand. Collected by Captain K. Moller, "Durraween," in August, 1929.

A further series has subsequently been obtained by the same collector on a ground east of Port Jackson, N.S.W., in 110 fathoms, on a circumscribed area, possibly only a few miles in extent. It is interesting to note that so far the female is unknown.

Description.—The length of the carapace is equal to approximately five-sixths of the breadth. The dorsal surface is uneven and the gastric areas are indicated by broad indistinct sulci; the two longitudinal depressions which lie on each side of the cardiac region are well marked. The central portion of the carapace is densely granulated, the granules becoming more scattered toward the lateral margins; the surface adjacent

to the posterior margin is smooth. There is an indistinct longitudinal ridge extending from the posterior margin which becomes lost in the convexity of the cardiac area.

The antero-lateral margin is shorter than the postero-lateral and is armed with four teeth, excluding the outer orbital angle; the first tooth is the smallest of the four. There is a fringe of hairs which extends just below the antero-lateral margin from the inner angle of the lower orbital border to the last tooth of the antero-lateral margin.

The postero-lateral margin is defined for one-half of its length by a granular ridge, which dwindles and disappears between the second and third walking legs, and is followed posteriorly by a smooth concave area which extends almost to the tympanum on the dorsal surface and to the lower edge of the epimeral wall.

The posterior margin is raised and outlined anteriorly by a row of uniform granules; it extends on each side of the carapace only past the base of the swimming leg.

The fronto-orbital border is equal to half the width of the carapace and is produced beyond the curve of the antero-lateral margins. The front is equal to the orbit in width and is armed with four spines; the two median ones are placed close together and are produced; the other two mark the lateral angles of the front and are very small.

The upper margin of the orbit is granulated and has only one cleft; the inner and outer angles are developed into long acute spines; the outer is more produced than the inner spine. The lower orbital margin is coarsely granulated and clothed with longer hairs than those on the upper margin. The inner angle is developed into a spine which is longer than other orbital spines. The orbits are large and deep, and the orbital hiatus is a little more than one-third the greatest width of the orbit; the antennae almost fill the orbital hiatuses and are free and movable. The antennules are large and unprotected by the front.

The epistome is sunken and hidden by the external maxillipeds. The buccal orifice is quadrate and completely closed by the external maxillipeds.

There is a ridge of elongated granules on each side of the body, extending parallel to and just below the line of demarcation between the sub-nepatic and pterygostomian regions; these serve as stridulating organs; and sound is produced by friction of the prolongation on the bases of the chelipeds against the ridges.

The maxillipeds are smooth; the merus is as long as the inner margin of the ischium. The anterior margin of the merus is very oblique; its outer angle rounded. The opposed edges of the meral articles are clothed with long stiff hairs.

The male abdomen is divided into six segments—the first two are each crossed by a strongly developed carina and are visible from above; the penultimate segment is the longest, and the last is set in a broad cleft in the anterior margin of the penultimate.

The chelipeds are elongated; the merus extends beyond the antero-lateral border for more than half its length; the dorsal surface is divided distally into two unequal facets by a longitudinal ridge which is covered with granules. The anterior facet is the broader and is smooth to the unaided eye; the posterior facet slopes steeply to the thickened border which is ornamented with scattered granules and hairs; the anterior margin is armed with four or more pro-curved small spines. The carpus is armed with three acute spines—one at the inner angle, one above the articulation with the manus, and one on the outer border opposite the spine on the inner angle. The manus is triprismatic; the dorsal surface has a median row of irregularly placed granules; the inner margin is more curved than

the outer margin and is armed on the distal half with five pro-curved acute spines (the series from east of Port Jackson have four instead of five spines); the proximal half of the margin is rounded and coarsely granulated; the outer margin is thin and granulated. The outer surface is minutely granulated, and there is a faintly marked longitudinal carina above the mid-line of the facet. The dactylus is triprismatic and longer than the upper margin of the manus; the upper surface is flat; the inner margin armed with four long pro-curved spines; the outer margin is granulated; the outer surface is faintly grooved. The opposed edges of the dactylus and immovable finger are armed with tricuspidate teeth, each of which fit into the space between the teeth of the opposing side.

The ambulatory legs are long and slender; the merus slightly compressed and ornamented with a fringe of hairs of distally diminishing length on the upper margin. The propodus is smooth and compressed; its upper margin carinated; there are three longitudinal rows of punctae on the broad surfaces.

The dactylus is slightly curved and almost as long as the two preceding articles together; the upper and lower margins bluntly carinated, and there are four rows of punctae—two on each of the broad surfaces.

The fifth legs are shaped for swimming and are unarmed; the margins of the articles are ornamented with fringes of long hairs, especially the lower margins of the propodus and dactylus.

Family XANTHIDAE. Subfamily ETISINAE.

Genus *PARAETISUS* *gen. nov.*

Paraetisus differs from *Etisus* H. Milne Edwards, to which it bears a superficial resemblance by having the fronto-orbital border more advanced; the front more advanced and transversely convex; the antennules more longitudinally directed and the buccal cavern much more elongate.

PARAETISUS GLOBULUS *sp. nov.*

Pl. xxiii., fig. 7.

Holotype male measuring 43 mm. total carapace width.

Type locality.—Gatcomb Head, Facing Island, Port Curtis, Queensland. Dredged in 10-15 fathoms on broken shell. June, 1929.

Description.—The carapace is broader than long; strongly convex in both directions. The gastric regions are faintly delimited, but the grooves on each side of the mesogastric regions are anteriorly distinct. The hepatic region is tumid and separated from the protogastric and the branchial regions by broad deep sulci. On the anterior portions of the protogastric areas there are numerous tubercles which are very strong in the * immature.

These tubercles are also found on the hepatic and near the antero-lateral margins. The antero-lateral margins are strongly curved, quadridentate, excluding the external orbital angle; the first tooth is subacute and spiniform though blunt; the other three teeth are broadly triangular. The front is narrow, produced, divided into two obliquely truncated teeth, the lateral angles of which are more advanced than the median. The slit-like notch bisecting the front extends almost on to the dorsum of the carapace.

The chelipeds are short and nodular. The ambulatory legs are short, thick and granulated on the distal articles.

* One small badly damaged specimen was collected at Albany Passage in 1928, where it was taken in the dredge in shallow water.

Subfamily ACTAEINAE.

Genus ACTAEA de Haan.

Actaea de Haan, Crust. in Siebold's Fauna Japonica, 1833, 4 and 18.

Actaea de Haan, Rathbun Bull., 152, U.S. Nat. Mus., Washington, 1930, 250.

Logotype *A. savignyi* (H. M. Edw.), 1834. Type locality: Red Sea.

ACTAEA CAPRICORNENSIS *sp. nov.*

Pl. xxii., figs. 1 and 2.

Holotype male measuring 13 mm. in total carapace width.

Type locality.—North West Island, Capricorn Group, Queensland. The specimen was taken from a mass of living corals brought up on an anchor from deep water outside the reef. November, 1927.

Description.—The carapace is more than half as long as it is wide. The dorsal surface is very areolated; over thirty areolae formed by groups or clusters of large smooth, partially fused granules. The inter-regional sulci are deep and filled with a short dense pubescence in which occasional single granules are apparent. The chelipeds and legs are ornamented with groups of granules similar in formation to those on the dorsum of the carapace. The margins of the ambulatory legs are fringed with long hairs.

The species appears to belong in the section of the genus in which *A. fragifera* (White) is found. However, the remarkable granulation which is its outstanding feature is sufficient to separate *A. capricornensis* from its allied species.

Genus CALVACTAEA *gen. nov.*

Calvactaea may be separated from the allied *Actaea* de Haan by the following characters:—

1. The carapace is convex, not only longitudinally, but also transversally.
2. The lack of regions on the dorsum of the carapace, as implied by the generic name.
3. The antero-lateral margins are entire.
4. The postero-lateral margins are strongly convergent posteriorly.
5. The front is between a quarter and one-fifth as wide as the carapace.
6. The upper orbital margin is not tumid.
7. There are very faint traces of sutures in the upper orbital margin.
8. The basal antennal article is very distinct; the downward prolongation of the front which delimits the antennular fossae is strongly developed.

CALVACTAEA TUMIDA *sp. nov.*

Pl. xxiii., fig. 9.

Holotype female measuring 21 mm. total carapace width.

Type locality.—Sow and Pigs Reef, Port Jackson, N.S.W. May, 1929. Dredged in shallow water.

Description.—The carapace is deep and smooth to the unaided eye; faintly rugose anteriorly and bare; it is very convex longitudinally and transversely so as to appear globular. The regions are undefined, though one or two faint lines extend back from the front; the most apparent is a bifid one which delimits the mesogastric area. Antero-lateral margins are entire and evenly granulated.

The chelipeds are unequal; the left is the larger. The manus is deep and externally smooth; the upper surface is granular. These granules are continued on to the proximal portion of the dactylus.

The species occurs associated with a soft coral, and the holotype was taken from a cavity within the body wall of the coral. Subsequent collect-

ing has shown that the species is comparatively common in the type locality, the larger males and females being found inside the coral, while the small males are found clinging to the outside and apparently cutting their way through the outer wall of the host; the site usually selected is the crotch at the base of one of the branches. The compartments from which the mature crabs are taken from are lined with a tough, dirty brown skin, similar in texture to the normal outer covering, and in some instances extended almost the entire length of the stem of the coral.

A small male has been collected by Captain K. Moller in 50 fathoms off Cape Hawke.

Subfamily PILUMNINAE.

Genus HETEROPILUMNUS.

Heteropilumnus de Man, Zool. Jahrb., viii., 1895, 527.

Logotype *H. stormi* de Man. Type locality: West Celebes.

HETEROPILUMNUS GRANULIMANUS *sp. nov.*

Pl. xxii., figs. 3 and 4.

Holotype male measuring 12 mm. in total carapace width.

Type locality.—North West Island, Capricorn Group, Queensland. November, 1927. The species occurs under the living coral on the New Caledonian area of the reef.

Description.—The carapace is broader than long, 12 by 9 mm., and is covered with short, thick tomentum which conceals the areolations. Scattered long hairs are most numerous on the margin of the carapace and limbs. A fringe of long hairs extends across and a little above the margin of the front between the eyes and continued on to them.

When the tomentum is removed the surface of the carapace is found to be smooth with the areolations distinctly delimited by shallow sulci. There are a few granules on the hepatic region near the antero-lateral margin; the granules become more numerous near the postero-lateral margin. The front is 4.5 mm. broad, with a gradual downward slope; the margin is smooth and divided into two lobes by a shallow median fissure. The inner orbital angles are not separated from the front.

The epistome is three times wider than it is long, smooth and without hairs. The anterior margin of the buccal frame is well produced outwardly and has four notches.

The antennules are folded transversely. The external maxillipeds are smooth and bare.

The pterygostomian and subhepatic regions are clothed with tomentum similar to that on the dorsum of the carapace. The eyes are small, well pigmented and fit snugly into the sockets. The upper orbital border has two obsolete fissures and its margin is granular; there is a third fissure below the outer orbital angle; the lower orbital margin is finely granular. The outer orbital angle is produced into a small nodule.

The antero-lateral margin is shorter than the postero-lateral margin and has four teeth. The teeth are separated by shallow grooves each capped by a few granules; the first tooth, which is contiguous with the outer orbital angle, is the broadest, and between it and the second tooth there is a wide V-shaped notch. The second, third, and fourth tooth have their anterior margin shorter than the posterior margins. The fourth tooth is the smallest of the series.

The chelipeds are subequal. The upper margin of the merus is thin and well curved, and it ends in an abrupt tooth near the distal extremity; a groove follows the line of the distal extremity from the base of the tooth to the articulation with the carpus. The carpus is covered externally with

pearly granules between the bases of which arise short stiff hairs intermixed with longer ones. The manus is more than half as high as it is long, and has the outer, upper, and lower surfaces covered with pearly granules tending to form definite longitudinal rows, the interspaces are filled with a very fine short tomentum, and there is a secondary growth of short stiff hairs intermixed with long ones. The granules on the lower border extend on to the proximal end of the immovable finger, but they become obsolescent on the outer side, their place being taken by punctae; there is a continuous line of similar punctae extending along close to and parallel with the lower border.

The dactyli of the chelae are granulated above for half the length; the granules, as on the immovable finger, fading into punctate grooves, one of which extends along the upper surface; the brown colour does not extend on to the manus.

The upper margins of the meri of the ambulatory legs are fringed with long hairs; the other surfaces are smooth and bare; the distal articles are clothed like the carapace, but the longer hairs are more numerous. The dactyli are slender and as long as the preceding article.

Subfamily MENIPPINAE.

Genus *PROLYBIA* *gen. nov.*

Prolybia differs from *Lybia* H. Milne Edwards, in the following characters:—

1. The carapace is broader and flatter in *Prolybia*; the antero-lateral margins are longer than in *Lybia*.
2. The front is more produced and narrower in *Prolybia*.
3. The external maxillipeds are broad in *Prolybia*.
4. The epistome is much shorter in *Prolybia*.
5. The orbits are deeper and more developed than in *Lybia*.
6. The ambulatory legs are short and thick in *Prolybia*.

PROLYBIA AUSTRALIENSIS *gen. and sp. nov.*

Pl. xxi., figs. 3 and 4.

Holotype female 7 mm. total carapace width.

Type locality.—Bottle and Glass Rocks, Port Jackson, N.S.W., 4/8/1928. The specimen was seated amongst bryozoans on the under surface of a large boulder below tide mark.

Description.—The carapace is broader than it is long. The front is produced and as wide as the antero-lateral margins are long; the margin is straight when viewed from above. The antero-lateral margins are armed with two large well-formed teeth. The orbita are large and the eyes well pigmented.

The body and limbs were clothed with long hairs which were in tufts upon the dorsal surface of the carapace; these were removed in order that the underlying characters might be studied.

The ambulatory legs are well formed and fringed with long hair. The species carries a living actinian in each cheliped, and even the process of killing would not force it to relinquish its grasp; the figure shows the actinians still held fast.

RATHBUNARIA *gen. nov.*

The status of *Rathbunaria* is at present uncertain; some features point to its affinity with the GONOPLACIDAE, while others place it amongst interesting intermediate genera which connect the GONOPLACIDAE to the XANTHIDAE.

The carapace is broader than it is long, hexagonal and depressed. The

orbits and the eyes are below the plane of the front and antero-lateral margins, and are invisible in a dorsal view. The upper margin of the orbit is in line with the antero-lateral margin of the carapace. The antero-lateral margins are half the length of postero-lateral margins. The buccal cavity is wider anteriorly than posteriorly. The basal antennal article just touches the downward prolongation of the front.

The epistome is deeply sunken, and the anterior and posterior margins are prominent.

The genus is named for Dr. Mary J. Rathbun, of the National Museum, Washington, for whose sympathetic and untiring interest and help I am deeply grateful.

RATHBUNARIA SCULPTISSIMA sp. nov.

Pl. xxiii., figs. 5 and 6.

Holotype female 13 mm. in total carapace width.

Type locality.—Thursday Island, Torres Strait. September, 1928. Found under a block of coral on the reef.

Description.—The carapace is flat; the areas are clearly defined and covered with short clavate setae which are arranged in irregularly reticulating lines. On the ambulatory legs these lines of setae stand upon a net work of low ridges. Upon the margins of the limbs the setae are longer but similarly clavate.

The orbits are below the plane of the front, and the antero-lateral margins are invisible in dorsal view. The orbital margin has two faint fissures above, also one just below the outer orbital angle; the lower border is entire; the outer surface is sculptured with irregular pits; these pits extend on to the outer surface of the first antero-lateral teeth. The sub-hepatic region is sculptured like the orbit.

The pterygostomian region is smooth. The chelipeds are subequal and deeply sculptured. The larger manus is as broad as its upper margin is long; the latter has a thick, sinuous crest extending from the articulation of the wrist to its distal extremity. The merus is deeply sculptured on its upper distal portion. The carpus is similarly sculptured and has a long spinate tooth at the inner angle. The crests of long, clavated setae occur on the margins of the manus.

The ambulatory legs are long, sculptured and hairy; the meri are as long as the last two articles together; the dactyli are considerably longer than the preceding article, except in the fifth pair in which all the articles are shorter; the propodi are slightly shorter than in the preceding leg but just as deep; the dactylus is extremely small, less than half the length of the dactylus on the preceding leg, and has a sharp upward curve.

Family CYMOPOLIIDAE.

Genus MANELLA Rathbun.

Manella Rathbun, Bull. U.S. Fish. Comm., 1903 (issued 1906), III., 837.

Haplotype *Manella spinipes* (de Man). Type locality: Amboina.

Pleurophricus spinipes de Man, Archiv. f. Naturges., 53, 1888, 344, pl. xv., fig. 1.

MANELLA BREVIMANA sp. nov.

Pl. xxi., figs. 7 and 8.

Holotype male measuring 17 mm. in total carapace width.

Type locality.—North West Island, Capricorn Group, Queensland. December, 1929. Collected from the under surface of a living coral growing at the edge of a pool in New Caledonian zone of the reef.

Description.—The carapace is broader than long, hexagonal. The

antero-lateral margins are very short, less than half the length of the postero-lateral margins, and are armed with three teeth, exclusive of the external orbital angles; the second tooth is strongly bifid; the third tooth is smaller than the first and considerably smaller than the second. The converging postero-lateral borders are armed with ten short acute spines. The posterior margin is armed with twenty-two short, broad, perpendicular spines, alternating in thickness, except the two median ones, which are equal in size; all, however, attain the same height.

The surface of the carapace is areolated; the deep inter-regional sulci are smooth and filled with long curved hairs which do not conceal the granulation on the regions. The granules are arranged as in both the other species of the genus, but are more salient in *M. brevimana*.

The fronto-orbital region is slightly broader than the posterior margin of the carapace; the front is quadridentate; the median notch is broadly U-shaped and has the inner pair of teeth advanced beyond the submedian; they are bifid and narrower than the submedian; the inner of the bifurcated teeth is acute.

The submedian teeth are broader than the median and have entire margins. Both pairs are strongly tilted upwards.

The orbits have two deep notches above. The spines upon the upper border are short, broad and blunt; four are situated between the inner angle and the first notch; two between the first and second notches, and three smaller spines equal in size between the second notch and the outer angle.

The lower orbital margin is broken by two deep notches; the innermost is the deeper and more marked of the two. The inner angle of the lower margin is spinate and produced beyond the corresponding angle of the upper margin and followed by two subequal sharp apines: the last of which forms one side of the deeper notch. There are three small spines between the notches. The outer orbital angle is a broad forward curving spine.

The sternal surfaces appear smooth to the unaided eye but are, in reality, thickly punctate. The segments of the male abdomen are practically fused; the sutures are faintly marked. The lateral margins of the male abdomen are slightly sinuous; the last segment has long hairs which are only visible under a lens.

The chelipeds are unequal and not as long as the carapace; the merus is almost concealed; a strong pro-curved spine is on the posterior margin near the distal extremity. There is a low crest extending not quite the length of the external surface of the carpus.

The manus has the upper surface clothed with fine curved hairs similar to those on the merus and carpus, and has two rows of spines and nodular granules along the upper margin; the external surface is smooth and shining; punctate under a lens; and the punctae tend to form horizontal lines. The inside surface of the manus has a faint patch of granules near the lower border, but there is no vestige of stridulating ridges; the upper margin is half as long as the lower margin. The dactylus is toothed and is more robust than the immovable finger. The immovable finger has a single low tooth which occupies its mid portion.

The smaller cheliped is slender, and both the dactylus and the immovable finger are finely toothed and have the tips spoonexcavate. The ambulatory legs have the meri inflated; all the articles are spinate; the first and last pairs of legs are subequal in length.

While at the National Museum, Washington, I was able to examine the type of *Manella gardineri* Rathbun and specimens of *Manella spinipes* de Man, and compared my type specimen with them. And in the following

key I have noted the more marked differences between the three species. White at the Paris Museum I was able to examine specimens of *Crossotonotus compressipes* identified by A. Milne Edwards. The published figure of this species is good, but one has to examine the actual specimens to appreciate the convexity, which is far greater than in *Manella* Rathbun. While on a recent visit to Rabaul, New Britain, I was fortunate in being able to collect a specimen of *Crossotonotus compressipes*, and in comparing it with the specimens of *Manella* I have noted the following important differences. *Crossotonotus* has a subcircular carapace, as shown in A. Milne Edwards' figure, the margins are not as spinate as in *Manella*. The front is narrower; the dorsal surface of the carapace is more convex and bare.

KEY TO THE SPECIES OF MANELLA.

<i>M. gardineri</i> Rath.	<i>M. brevimana</i> sp. nov.	<i>M. spinipes</i> (de Man).
Median frontal teeth broad; lateral frontal teeth slightly uptilted.	Median frontal teeth narrow; lateral frontal teeth strongly uptilted.	Median frontal teeth rounded, narrow. Lateral frontal teeth uptilted. Groove between median and lateral pairs greater.
Inner lower orbital angle a bifid spine with truncated tips.	Inner lower orbital angle produced into tridentate spine; each spine sharp.	Inner lower orbital angle produced into bifid spine.
Lower orbital border not strongly spined.	Lower orbital border with strong spines.	Lower orbital border with two slender spines.
Two spines on the eye stalk—the one at end well developed horn-like with strong upward curve.	Two blunt spines on eye stalk—one on distal end; other near edge of the corners. Neither as strong as in <i>gardineri</i> .	Two blunt spines on the eye stalk, but not as developed as in other species.
Granules on carapace low.	Granules on carapace salient.	Granules resemble <i>gardineri</i> .
Abdominal segments of male well marked.	Abdominal segments of male fused; sutures faintly marked.	Abdominal segments well marked.
Hooked hairs on carapace and limbs short. Major chelae longer than the carapace.	Hooked hairs on carapace and limbs long. Major chelae not as long as the carapace.	As in <i>brevimana</i> . Major chelae longer than the carapace; more robust than in either of the other species.
Arm extends more than half its length beyond the antero-lateral margin.	Arm just visible beyond the antero-lateral margin.	Arm s in <i>M. gardineri</i> .
Crest on the anterior margin of the arm five-toothed.	Crest on the anterior margin of the arm three-toothed; more salient than in <i>gardineri</i> .	Crest on anterior margin of arm four-toothed; more salient than in either of the other species.

<i>M. gardineri</i> Rath.	<i>M. brevimana</i> sp. nov.	<i>M. spinipes</i> (de Man).
Wrist with entire crest extending longitudinally along the upper outer surface.	Wrist with crest broken in two; more salient than in <i>M. gardineri</i> .	Wrist with spine and salient crest.
Hand twice as long as broad, widening distally.	Hand broad, short, not widening distally.	Hand twice as long as broad.
Upper margin of hand a little more than half the length of the lower.	Upper margin of hand less than half the lower.	Upper margin of hand half the length of the lower.
Stridulating ridges present.	No stridulating ridges	Lower margin granulous, strongest at base of pollex.
Inner surface of hand with a small patch of hairs distally.	Inner surface of hand bare; a spot of brown near the gape.	Distal inner surface of hand tomentose.
Dactyli of walking legs with more than three spines on their posterior margins.	Dactyli of walking legs with three or less spines on their posterior margins.	Dactyli with 2-3 spine, but the third always very small.

Family OCYPODIDAE. Subfamily MACROPHALMINAE.

Genus CLEISTOSTOMA.

Cleistostoma de Haan, Siebold's Fauna Japonica, Crust., 1835, 26.

Logotype *Cleistostoma dilatata* (de Haan) = *Ocypode* (*Cleistostoma*) *dilatata* de Haan, tom. cit., 55, pl. xv., fig. 2. Type locality: Japan.

CLEISTOSTOMA MCNEILLI * sp. nov.

Pl. xxi., fig. 1.

Holotype male measuring 8 mm. in total carapace width.

Type locality.—Port Curtis, Queensland. December, 1929. The species occurs on mangrove and mud flats.

Description.—The carapace is smooth and bare; the regions are indicated, and a strong transverse ridge extends across the cardiac region. The antero-lateral margins are divergent posteriorly and have three teeth, including the outer orbital angle. The front is broad, its margin is sinuous, and produced downwards at the middle and at each end.

The chelipeds are equal in size. The manus is swollen, smooth and bare. The dactyli and immovable fingers are slender and gaping, and a single quadrate tooth is on the proximal half of each of the dactyli. The ambulatory legs are clothed with long hairs. The sternum is punctate.

Subfamily SCOPIMERINAE.

Genus ILYOPLAX.

Ilyoplax Stimpson, Proc. Acad. Nat. Sci., Philadelphia, x., 1858, 98 (44).

Tympanomerus Rathbun, Proc. Biol. Soc. Washington, xi., 1897, 164.

Ilyoplax Stimpson, Rathbun, Proc. Biol. Soc. Washington, xxxiv., 1921, 156 (footnote).

Haplotype *Ilyoplax tenellus* Stimpson. Type locality: Canton, China.

* Named for my good friend F. A. McNeill, of the Australian Museum staff, whose able criticism has gone far in helping me with my studies.

ILYOPLAX DENTATA sp. nov.

Pl. xxii., figs. 5 and 6.

Holotype male measuring 6 mm. in total carapace width.

Type locality.—Port Curtis, Queensland. June, 1929. The species occurs on the mangrove mud flats.

Description.—The surface of the carapace is uneven; the regions are distinctly indicated. The antero-lateral margins are very short; a single obtuse tooth indents the antero-lateral margin behind the external orbital angles.

The eyes are large and the orbits are directed obliquely backward.

Strong ridges define the postero-lateral and posterior margins. The front is broad and strongly deflexed; the frontal lobes are well developed; the actual margin is entire. The hands are equal in size and smooth on the upper outer surfaces. The upper margin is marked by a line of even granules; a longitudinal ridge of granules ornaments the lower border of the immovable finger; this ridge extends along and fades out on the proximal portion of the manus, as well as on the distal extremity of the immovable finger.

The carpus of the cheliped is armed with a long spine at the inner angle. The tympana of the ambulatory legs are not strongly developed.

The fifth segment of the abdomen is characteristically constricted.

The species is related to *I. orientalis* (de Man).

Superfamily OXYRHYNCHA. Family MAJIDAE.

Subfamily MAJINAE.

PRISMATOPUS gen. nov.*Prismatopus* is characterised by having the articles of the walking legs triprismatic in transverse section. The margins of the buccal frame, the external maxillipeds, the basal articles of the antennae and the lower margins of the outer orbital spines are produced into thin carinae. Basal articles of the antennae are narrow and deeply crenated, so that the orbits are incomplete below.*Prismatopus* is related to *Acanthophrys* A. Milne Edwards-Miers, but is readily separated by the following characters:—

1. The spine on the outer angle of the basal antennal article is directed transversely instead of forward.
2. The merus of the external maxillipeds is notched to receive the palp.
3. The articles of the walking legs are triprismatic in section.
4. The margins of the maxillipeds are produced into carinae.

PRISMATOPUS ALBANYENSIS sp. nov.

Pl. xxiii., fig. 3.

Holotype female measuring 22 mm. total carapace width * by 15 mm. broad.

Type locality.—Albany Passage, North Queensland. Dredged in 9-12 fathoms. September, 1928.

Description.—The carapace is elongate, ornamented with few dorsal spines. Its surface is smooth, with a few scattered tubercles near the posterior border. Three spines lie in a longitudinal line along the mid-line of the carapace—one anteriorly, inclined on the anterior part of the mesogastric region; the second is placed further back on the same region; a

* The measurements for the holotype have been taken longitudinally from the notch between the rostral spines to the posterior border of the carapace. The lateral measurement is made across the widest part—not at the tips of the lateral spines.

pair of spines placed in a transverse line on the cardiac region; a low ridge connects the bases of these spines with the spine on the mesogastric region. The hepatic area protrudes beyond the outer orbital angle and is armed with two equal sized spines directed backward. There are two outwardly directed, shorter more slender spines upon the meso-branchial region; the anterior of the two is directed transversely, and the posterior one is directed towards the postero-lateral margin.

The supra-ocular eave is developed distally into an acclivous spine; on upper surface a carina extends.

The outline of the basal antennal article is marked by sharp carinae, as also are the antennular fossae; the antero-lateral angles of the latter have a well-formed sharp spine, with a forward and downward inclination. The margins of the buccal frame are produced into thin, sharp carinae, similar to those on the antennal article.

The rostrum is formed of two divergent spines, fused at the base for a short distance; each is dorsally convex, but flat on the under surface.

The merus of the cheliped is flattened, and has the upper, outer margin produced into a carina which is broken into four subacute teeth by two sweeping curves; the lower margin is produced in a similar fashion, but has only two teeth. The carpus has three well marked longitudinal carinae. The manus is compressed and smooth and the margins are carinated; the dactylus and the immovable finger are acute at the tips and without teeth on their opposed margins.

The ambulatory legs are long and slender and triprismatic in section.

Genus PARAMITHRAX.

Paramithrax H. Milne Edwards, Hist. Nat. Crust., 1, 1834, 323.

Logotype *P. barbicornis* (Latreille), specified by E. Desmarest in Chenu, Encyc. Hist. Nat., 1858, 14. Type locality: Australasia.

PARAMITHRAX PARVISPINOSUS *sp. nov.*

Pl. xxiii., fig. 4.

Holotype female measuring 9.5 mm. in total carapace length.

Type locality.—North West Island, Capricorn Group, Queensland. May, 1930. The species inhabits the under surfaces of the living corals on the outer edge of the reef, where it covers itself with living sponges.

Description.—The carapace is longer than it is broad and less hairy than in *P. minor* Rathbun (*nec.* Filhol).* The granules and spines on the dorsal surface are few in number; those present are confined for the most part to the gastric and cardiac regions. There is a well developed reflexed spine on the postero-external corner of the meso-branchial region; a smaller similarly shaped spine is placed on a lower plane further forward on the same region.

There are two well-developed acclivous spines on the posterior margin. The rostrum is narrow and composed of two broad divergent spines. The eye stalk is short and thick and the cornea is large. The basal article of the antennae has its antero-external angle produced laterally into a broad spine, clearly visible from a dorsal view. The lateral margins of the carapace are much less spinate than in the allied species *P. minor* Rathbun.

* *Paramithrax minor* Rathbun, Biol. Reslts., Endeavour, v., 1, 1918, 18.

Explanation of Plate xxi.

Cleistostoma mcneilli.

- Fig. 1. Dorsal view of the holotype measuring 8 mm. in total carapace width. Port Curtis, Queensland.
 „ 2. Ventral view of same. The abdomen and masculine appendages have been removed.

Prolybia australiensis.

- „ 3. Dorsal view of holotype measuring 7 mm. in total carapace width. Bottle and Glass Rocks, Port Jackson.
 „ 4. Ventral view of same. Note the anemonies held in each chela.

Lissomorpha haswelli.

- „ 5. Dorsal view of the holotype measuring 9 mm. in total carapace width. Dredged off Gatcomb Head, Facing Island, Port Curtis, Queensland.
 „ 6. Ventral view of same.
 „ 6a. The maxillipeds of *L. haswelli*. Note the broad exopodite.

Manella brevimana.

- „ 7. Dorsal view of the holotype measuring 17 mm. in total carapace width. North West Island, Capricorn Group, Queensland.
 „ 8. Ventral view of same. Note the healed-up wound near the larger cheliped.

Plate xxii.

Actaea capricornensis.

- Fig. 1. Dorsal view of holotype measuring 13 mm. in total carapace width. North West Island, Capricorn Group, Queensland.
 „ 2. Ventral view of same.

Heteropilumnus granulimanus.

- „ 3. Dorsal view of holotype measuring 12 mm. in total carapace width. North West Island, Capricorn Group, Queensland. Note the right half of the carapace has been denuded.
 „ 4. Ventral view of same.

Ilyoplax dentata.

- „ 5. Dorsal view of holotype measuring 6 mm. in total carapace width. Port Curtis, Queensland.
 „ 6. Ventral view of same.

Cryptocnemus planus.

- „ 7. Dorsal view of holotype measuring 6 mm. in total carapace width. Dredged in the lagoon at Lady Musgrave Island, Bunker Group.
 „ 8. Ventral view of same.

Plate xxiii.

Gonioneptunus whiteleggei.

- Fig. 1. Dorsal view of holotype measuring 35 mm. in total carapace width. Trawled within a radius of 10 to 15 miles off Newcastle, N.S.W., 40 to 50 fathoms. Trawler "Goolgwai." Collected by Captain K. Moller.
 „ 2. Ventral view of same.

Prismatopus albanysensis.

- „ 3. Dorsal view of holotype length of carapace 22 mm.; breadth 15 mm. Dredged in Albany Passage, North Queensland.

Paramithrax parvispinosus.

- Fig. 4. Dorsal view of holotype measuring 9.5 mm. in total carapace length. North West Island, Capricorn Group, Queensland.

Rathbunaria sculptissima.

- „ 5. Dorsal view of holotype measuring 13 mm. in total carapace width. Thursday Island, Torres Strait.
„ 6. Frontal view of same.

Paraetisus globulus.

- „ 7. Dorsal view of holotype measuring 43 mm. in total carapace width. Dredged off Gatcomb Head, Facing Island, Port Curtis, Queensland.

Jonas leuteanus.

- „ 8. Dorsal view of holotype measuring 30 mm. in total carapace width. Dredged near Lindeman Island, Cumberland Group, Queensland.

Calvactaea tumida.

- „ 9. Dorsal view of holotype measuring 21 mm. in total carapace width. From Spongodes. Dredged near the Sow and Pigs Reef, Port Jackson, N.S.W.

Lyreidus australiensis.

- „ 10. Dorsal view of holotype male measuring 44 mm. in carapace length. Taken within a radius of 10 to 15 miles off Newcastle, N.S.W. 45 to 50 fathoms. November, 1931. Captain Moller. Trawler "Goolgwai."

Aeneacancer mollerii.

- „ 11. Dorsal view of holotype measuring 54 mm. in total carapace width. Trawled near Montague Island, N.S.W.

ON MANAGEMENT AND BREEDING OF BUDGERIGARS IN CAPTIVITY.

(Read to members of the Budgerigar Club on 21st March, 1933.)

By ERNEST W. JONES.

The aims and objects of the Budgerigar Club are to foster and improve the breeding of Budgerigars in captivity, and we are all anxious to learn how this may be done to the best advantage.

I have been requested to relate my experiences on the management of my birds, and have pleasure in submitting to you the methods I adopt. In so doing I wish it to be clearly understood that I do not consider my methods are letter perfect, and any other way must be wrong, for it is freely admitted that what I don't know about these delightful and fascinating birds would fill a very large book. However, I think it will be admitted that I have had some little success with them, and if my effort proves to be of some little service to any of my listeners I will be more than pleased.

I have spent many pleasant holiday jaunts in the bush and vast open spaces of this fair country of ours during the past 30 years, including an overland trip from Darwin to Sydney, and have had the opportunity of seeing many kinds of birds in their native state. I have seen thousands of Budgerigars in all stages of development in their wild state, but never have I seen other than the natural green variety, nor have I seen what you all know as "Runners."

It is very gratifying to know that this beautiful miniature Australian parrot has endeared itself to many thousands of bird lovers in all parts of the world, and has become so domesticated that the merest amateur has very little difficulty in inducing it to settle down and set about the business of rearing a family in captivity. But I have not met many people who can claim they have mastered the art of breeding them successfully. When I say breeding them successfully, I mean producing the maximum of strong robust and healthy birds that fly when they leave the nest, not flop out on the floor half naked and spend months running round the aviary or crawling up the wires looking the picture of misery, wishing they had never been born, when they see their more fortunate relatives sporting round the flight and enjoying life to its fullest degree.

We have yet, among other things, to master that dreaded malady, known to the more scientific as French Molt, or, to use the vernacular expression, the breeding of "Runners" or "Hikers," as they are sometimes called. Much to my disappointment I have experienced the breeding of "Runners" and, recognising that there must be a cause, I set myself the task of finding that cause, if possible, and do my best to overcome it or reduce it to a minimum. I gave the matter very much thought, and decided to try and reason out why these undesirables are produced in our aviaries and not seen in the bush. Having concluded that the seat of the trouble was careless mating, over-breeding, breeding out of season, and breeding from immature stock birds, I decided to test out my theory. I may say that in arriving at the abnormal causes I gave considerable thought as to how and when the birds breed and feed in their wild state, and decided to get as near to nature as possible.

From observations made during many visits to the western and north-western parts of this State and south-west Queensland, I learned that Budgerigars and kindred birds depend mainly on the supply of suitable

foods in the form of semi-ripe seeds of certain weeds and grasses with which to feed their young, and that their breeding activities are controlled by the supply of such seeds. Particularly have I noticed that after a bad winter, when the growth of grass and herbage was very poor, wild birds were not breeding and could be seen in large flocks. On the other hand, after a mild winter, followed by early spring rains and there was an abundance of grass and herbs, old birds were only found in ones and twos and young birds were plentiful. Now, birds housed in our aviaries are at all times well supplied with feed in full and plenty, and, Budgerigars being of a very vigorous nature, are willing to breed throughout the whole year. But is it right to allow them to do so?

I think you will all agree that Nature provides a certain part of the year as the most suitable time for breeding activities in most birds and animals, namely, the spring and early summer, and also wills it that they are compulsorily rested from breeding during the remainder of the year.

Of late years we have heard quite a lot from people in all walks of life on the subject of birth control. Perhaps a few thoughts on this subject applied to our Budgerigars may not be out of place. By way of illustration allow me to stray from birds for a moment to a man who owns a delicate machine or say a motor car. How long would either go on doing its best for him if he did not lay it up for adjustment periodically? Then, again, there is the farmer. He fallows and rests his land in order to ensure better crops. The same argument, I contend, applies to our birds. They need rest at certain times of the year and should not be allowed to breed ad lib. During the heat of summer, when the land is parched and dry and natural feed is scarce, and in winter with its extreme cold, birds in their wild state have to move over a wider area in search of food in order to live; whilst doing this they have no time for the rearing of families, so breeding ceases and the birds are thus rested.

Thus prompted, I decided to try control breeding my Budgerigars, and to breed them as near as possible in the natural breeding season (spring and early summer) as possible. From results, I have proved to my own satisfaction, that, provided your breeding birds are of mature age (that is 9 months old or more), of known breeding and in robust health, if mated during the latter part of July, they will, if supplied with a liberal ration of green feed and seeding grasses, in addition to a mixture of seeds (I recommend 5 parts millet, 3 parts plain canary seed and 2 parts hulled oats), produce for you perfect youngsters during the period August to early December. I would urge you not to allow your birds to produce more than 2 broods of young, and do not recommend breeding later than mid-December, as from then on the heat is too distressing on the parent birds and the young in the nests are almost stifled during the greater part of the day, and (as this is the time the red mites make their presence known) they are in many cases harassed almost to death during the night by these pests. Personally, I do not favour breeding during the winter either, owing mainly to the risk of losing hens through egg-binding and other troubles.

I have tried breeding as late as January and February by way of experiment, but the young birds produced were real degenerates in comparison to their brothers and sisters that were bred during the period I have recommended. During December, as opportunity presents itself, I break up the pairs, remove nesting boxes and separate the sexes, placing the males in a separate aviary to the females and compel them to rest from breeding till the following July. Whilst thus separated I feed on millet only, except

during the moult, when I occasionally give an added tit bit in the way of canary seed and hulled oats. Early in July I select the hens I intend breeding from; these are later mated to selected males and each pair is placed in separate breeding compartments; the size of the compartments is roughly 24 in. long, 18 in. deep and 18 in. high, where they remain till breeding finishes.

By this system they are free from outside interference, and I am sure that the young ones produced in any one compartment are from the particular pair of birds therein. Whereas, whilst I had my breeding pairs all flying loose in the aviary, there was no certainty as to correct parentage, for on several occasions I have seen as many as three males mate with one female in as many minutes. Any of you who have read Dr. Duncker's book on matings will see that he also experienced this, as he states: "It must at all times be remembered that any male bird in an aviary may possibly be the father of any young bird bred in such aviary."

I use a box type nest about 9 in. x 5 in. x 5 in. deep with the top hinged. The bottom of the nest box is made of 1 in. or $1\frac{1}{4}$ in. timber, in which a hollow about 4 in. in diameter and about $\frac{3}{4}$ in. deep is made at the end furthest from the entrance. The entrance should always be on the side of the nest in order that the sitting hen may be more secluded. The entrance to the nest is made in the form of a spout about 4 in. long, usually a piece of bamboo, with a hollow about $1\frac{1}{2}$ in. to $1\frac{3}{4}$ in. diameter. For nesting material I use a small quantity of coarse sawdust or fine mill shavings placed in the hollowed part of the nest.

When the young leave the nest they are ringed with numbered aluminium rings, and particulars of them entered in a stud record book. Celluloid rings are not so good, as they are inclined to perish and become soft and the birds are able to remove them. This leads to trouble, as a bird without a permanent identification mark is hard to identify with certainty, and in order to mate your birds later on it is very important that you should be sure of their breeding. When the young are sufficiently strong to be removed from the parents, they are turned into a large aviary, with a wire flight attached; the larger the flight the better in order that they may take plenty of exercise, as exercise plays a very important part in the making up of show specimens.

The breeding of new coloured varieties is a separate study which I will leave for a more able pen than mine to describe, but if you can master the art of breeding first, the production of new colours will be made so much easier to experiment with later on.

In conclusion, I would strongly urge you as fanciers to practise control breeding your Budgerigars, aim at producing quality not quantity, study your matings, breed only from matured stock at the right time (Nature's time, i.e., spring and early summer), feed your birds well, ring all your stock with metal rings so that you may know with certainty at any time how each bird is bred, and you will derive pleasure in improving your stock by producing birds in your aviary that are strong, robust and healthy that will more than repay you for the extra trouble.

REVIEWS.

Jacko, the Broadcasting Kookaburra, His Life and Adventures, by Dr. Brooke Nicholls. Illustrated by Dorothy Wall. Sydney, Angus & Robertson, Ltd. 1933. 4/6.

Those who have met Dr. Brooke Nicholls, or heard him in one of his travel talks, will admit that as a raconteur on natural history subjects he has much to say and all to the point. He tells the life-story of Jacko the Kookaburra, who was trained from a helpless fledgling to the much-travelled professional broadcaster of his natural laugh. This is divided into sections—the early period as told by himself (translated, no doubt, by Dr. Nicholls!); his introduction to the world as the first broadcaster of laughs, and his experiences during a caravan lecture tour of 4,000 miles over eastern Australia.

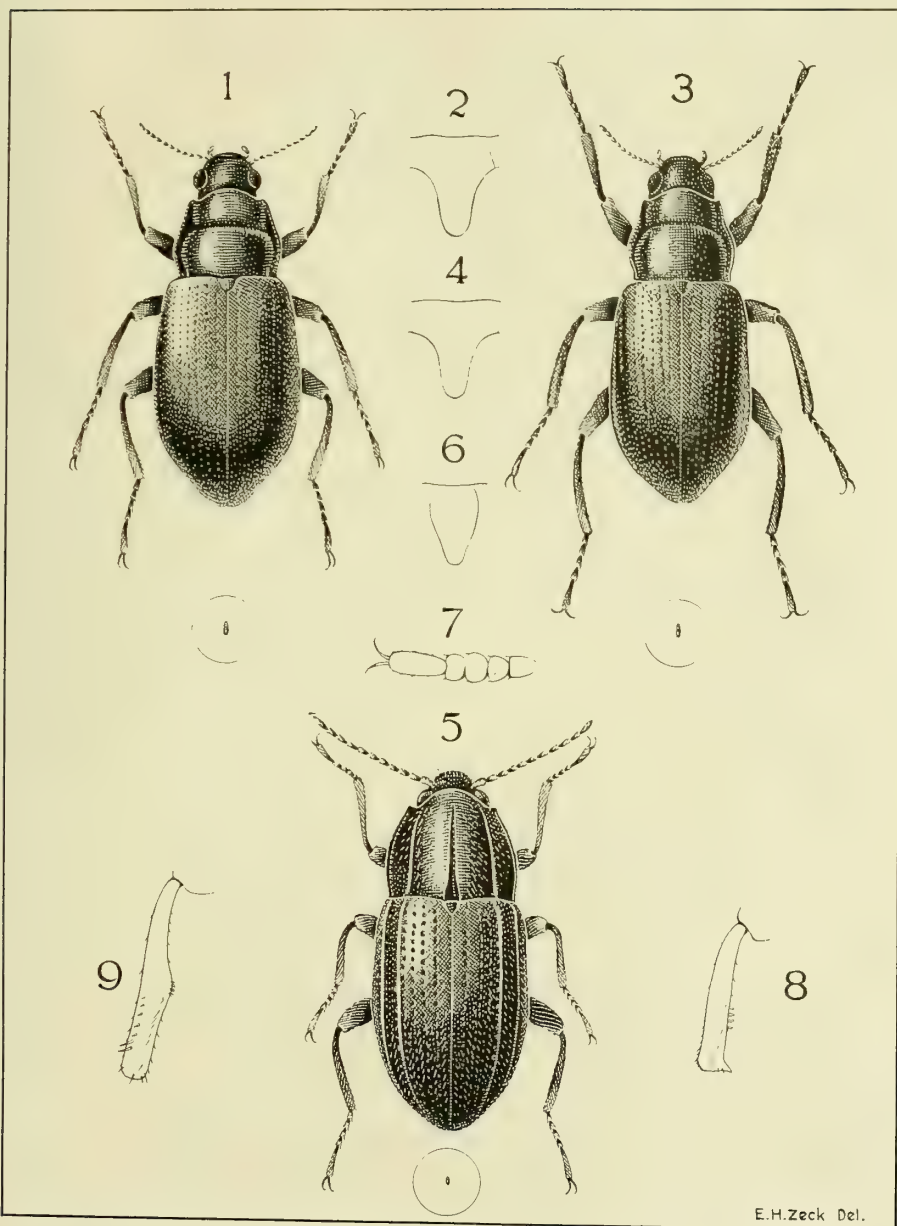
A quaintly humorous tale, full of amusing situations, occasioned by the friendship of the bird with Splinter the dog and Ginger the cat, with a wonderful gallery of portraits and situations, by a black and white artist, who has entered into the spirit of the tale and transcribed many of its most moving incidents into pen-pictures. A book for both young and old.

Gulliver in the Bush, by H. J. Carter. Sydney. Angus & Robertson, Ltd. 1933. 6/-.

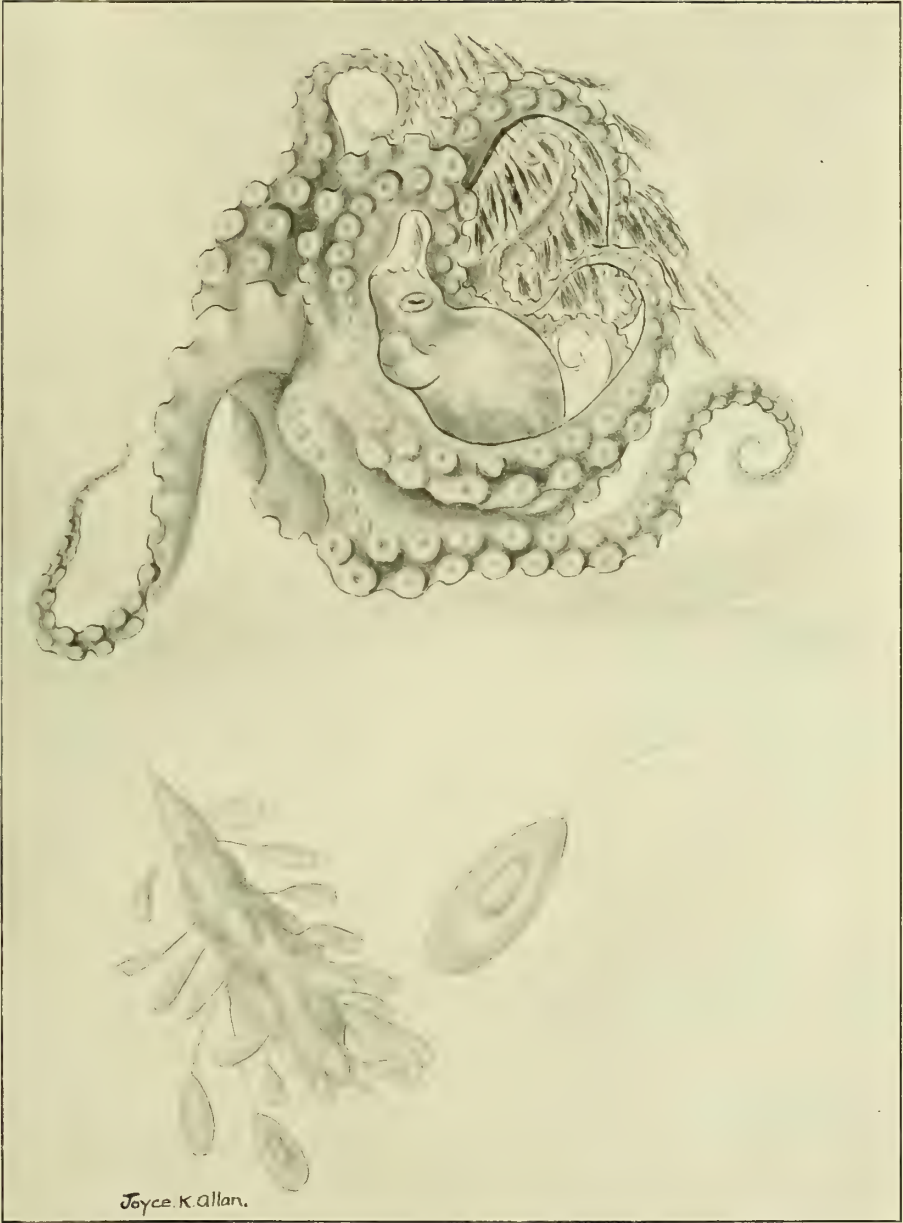
For over thirty years Mr. Carter has been known as an energetic collector of beetles, and the welcome companion of others who pursue the game and other "small deer" usually sought after by naturalists. In this book he has "collected" his reminiscences of travel throughout this vast continent of Australia, and at once transports his readers to the various localities, placing them under the great trees of the rain forest, amongst the bushes of the coastal scrub, or the spinifex of the desert regions, and with him they enjoy the capture of some new species and gloat over its metallic lustre or gorgeous bands of colour. Every collector (and aren't we all?) can experience the author's thrills, and compare them with his own under similar conditions. Eminently designed for the coleopterist, this chatty little work can be read with pleasure by all field naturalists. The 20 illustrations are from photographs taken on one or other of the collector's journeys.

The Cult of the Goldfish, by T. C. Roughley. Sydney. Angus & Robertson, Ltd. 1933. 6/-.

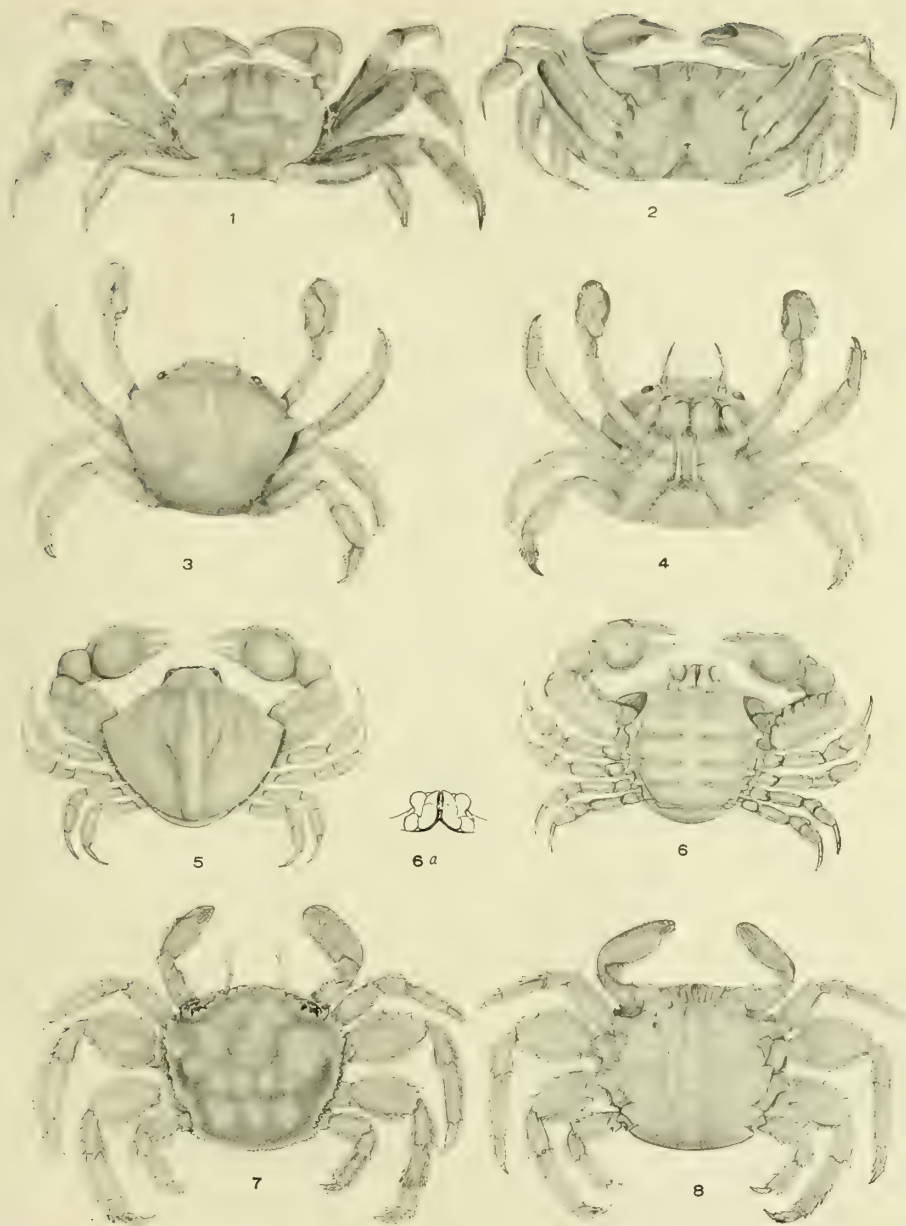
Last year, Mr. Roughley published a pamphlet, entitled *The Goldfish in the Home*, and the success of this small work led to the preparation and launching of a much more ambitious volume. In twelve sections, illustrated by over 60 photographs and text-figures, the author writes instructively of the aquarium, and its planting, varieties of goldfish and their food, scavengers and pests, spawning and development, diseases and parasites. Practical hints are given in relation to every phase of the cult, while the illustrations provide an indispensable guide to the amateur. Needless to say, the subject is treated in a comprehensive and masterly manner by an experienced scientist. A beautiful frontispiece in colour from the brush of Mr. Neville Cayley forms an added charm to a most useful publication.



THREE NEW SPECIES OF DRYOPIDAE.

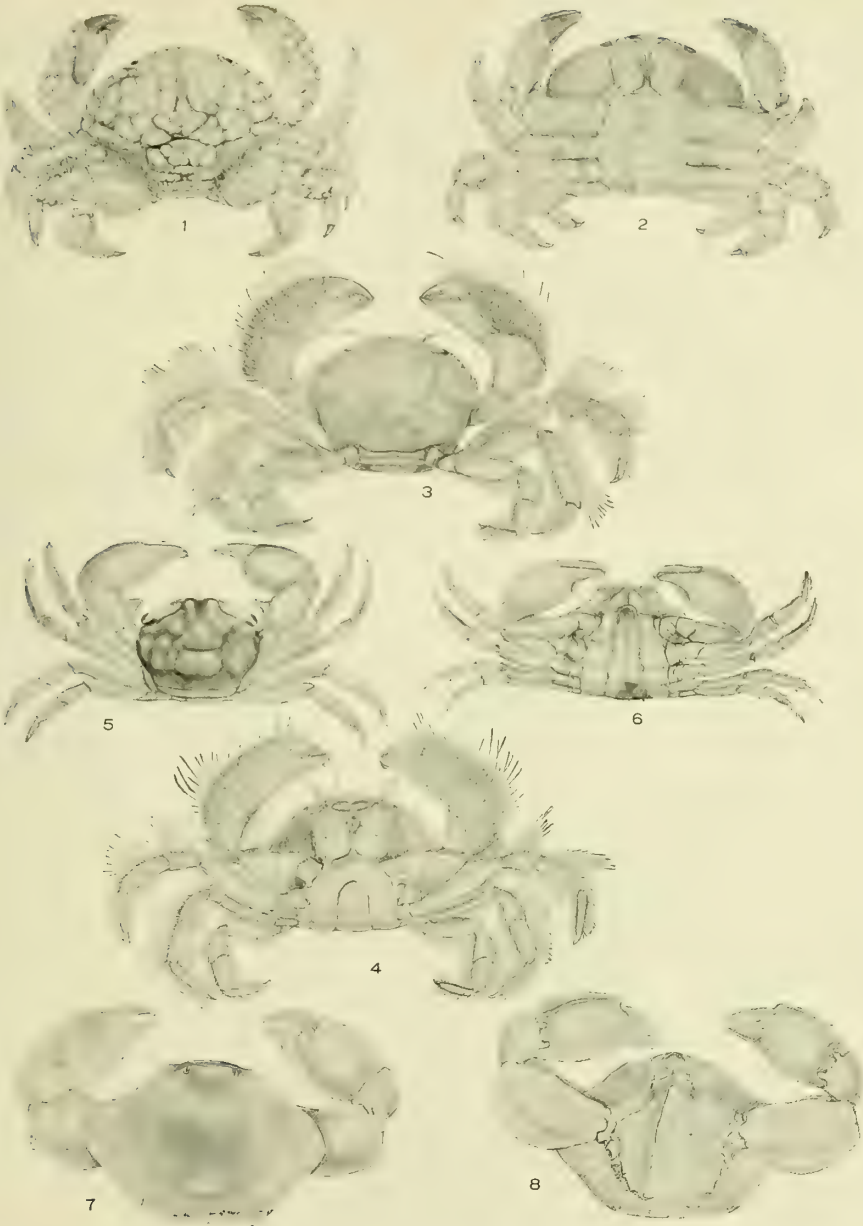


THE SYDNEY OCTOPUS (*O. CYANEUS*) BREEDING IN CAPTIVITY.

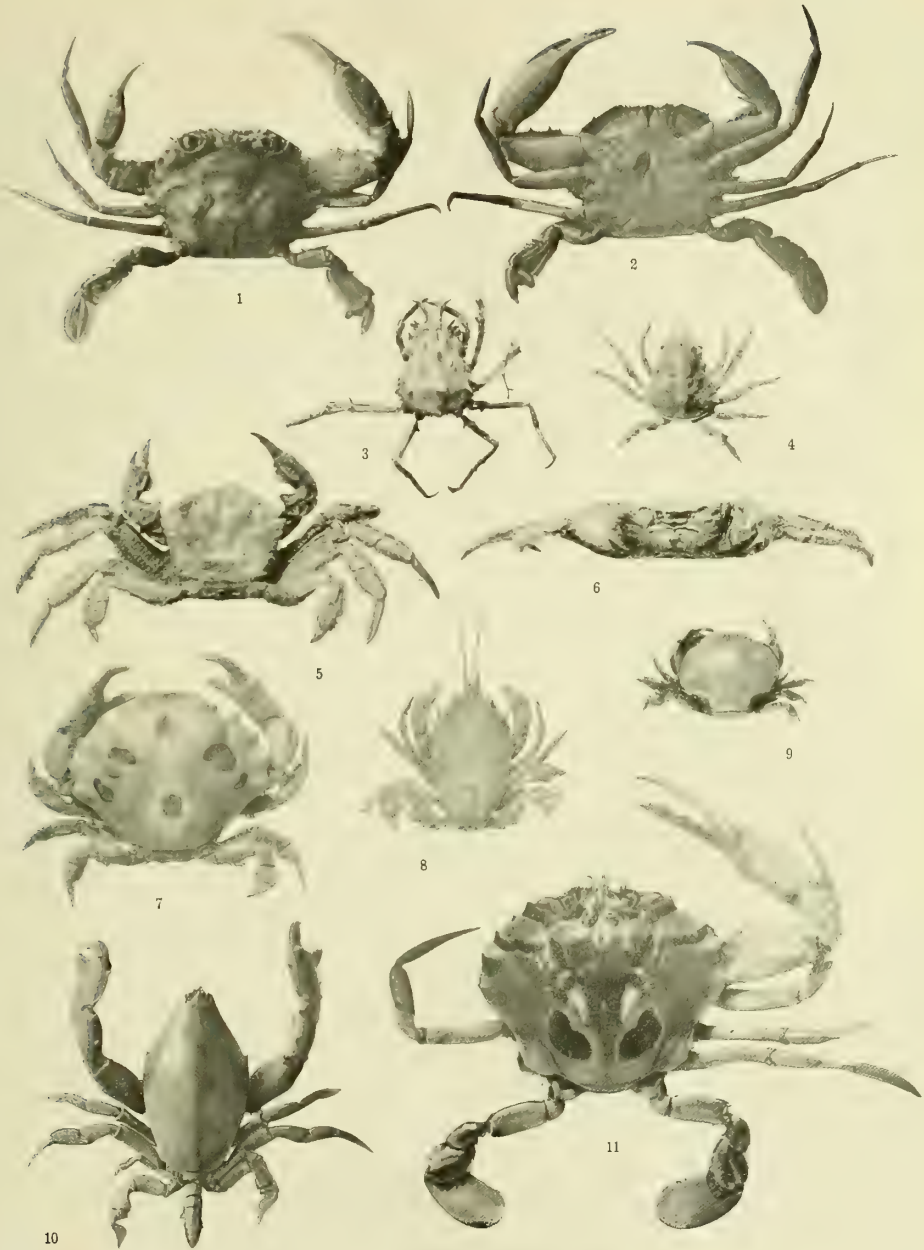


NEW MARINE DECAPODA BRACHYURA.

E. A. King, del.



E. A. King, del. NEW MARINE DECAPODA BRACHYURA.



NEW MARINE DECAPODA BRACHYURA.

From photographs by The National Museum, Washington (Figs. 3, 4, 5, 6, 7, 8, 9, and 11), and G. C. Clutton (Figs. 1, 2 and 10).

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